WINTER RATIONS FOR BREEDING EWES

OHIO

Agricultural Experiment Station

WOOSTER, OHIO, U. S. A., MAY, 1922

BULLETIN 358

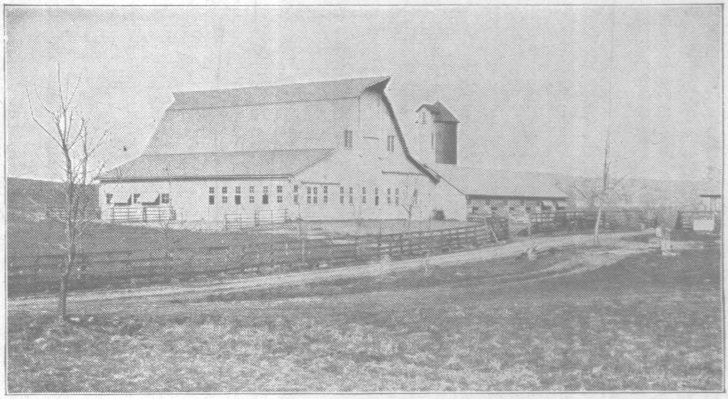

Fig. 1.—Sheep barn and sheds at Southeastern Test Farm, Carpenter. Another shed similar to the one shown on the right side of the barn is not shown in the illustration

The Bulletins of this Station are sent free to all residents of the State who request them. When a change of address is desired, both the old and the new address should be given. All correspondence should be addressed to EXPERIMENT STATION, Wooster, Ohio

OHIO AGRICULTURAL EXPERIMENT STATION

BOARD OF CONTROL

JOHN KAISER, *President* ..... Marietta
T. C. MENDENHALL, *Vice-President* ..... Ravenna
JOHN F. CUNNINGHAM ..... Cleveland
O. E. BRADFUTE ..... Xenia
CHARLES F. KETTERING ..... Dayton
BENJ. F. MCCANN ..... Dayton
LAWRENCE E. LAYBOURNE ..... Springfield
L. J. TABER, *Director of Agriculture* ..... Columbus

CARL E. STEEB, *Secretary*

STATION STAFF

C. G. WILLIAMS, *Director*

ADMINISTRATION

THE DIRECTOR, *Chief*
WILLIAM H. KRAMER, *Bursar*
W. K. GREENBANK, *Librarian*
CLARENCE M. BAKER, B. S., *Editor*

AGRONOMY

C. G. WILLIAMS, *Director, Chief*
F. A. WELTON, M. S., *Associate*
J. B. PARK, Ph. D., *Associate*[1]
L. E. THATCHER, Ph. G., *Assistant*
C. A. PATTON, *Assistant*
C. E. DIKE, B. S., *Field Assistant*
WILLIAM HOLMES, *Farm Manager*

ANIMAL INDUSTRY

G. BOHSTEDT, M. S., *Chief*
D. C. KENNARD, B. S., *Associate*
W. L. ROBISON, M. S., *Assistant*
C. H. HUNT, A. M., *Assistant*
A. R. WINTER, M. S., *Assistant*
P. S. WHITE, B. S., *Assistant*

BOTANY

A. D. SELBY, B. S., *Chief*
TRUE HOUSER, B. S., *Asst.*, (Germantown)
FREDA DETMERS, Ph. D., *Assistant*
ROY C. THOMAS, M. A., *Assistant*
M. J. YOUNG, M. S., *Assistant*

CHEMISTRY

J. W. AMES, M. S., *Chief*
C. J. SCHOLLENBERGER, *Assistant*
MABEL K. CORBOULD, *Assistant*
RAUB H. SIMON, A. M., *Assistant*
V. H. MORRIS, A. B., *Assistant*

CLIMATOLOGY

W. H. ALEXANDER, *Chief* (Columbus)[2]
C. A. PATTON, *Observer*

DAIRYING

C. C. HAYDEN, M. S., *Chief*
A. E. PERKINS, M. S., *Assistant*
C. F. MONROE, B. S., *Assistant*

ENTOMOLOGY

H. A. GOSSARD, M. S., *Chief*
HERBERT OSBORN, D. Sc., *Associate*[1]
J. S. HOUSER, M. S. A., *Associate*
W. V. BALDUF, M. S., *Assistant*

FORESTRY

EDMUND SECREST, B. S., *Chief*
J. J. CRUMLEY, Ph. D., *Assistant*
F. W. DEAN, B. S., *Assistant*
O. A. ALDERMAN, B. S., *Assistant*

HORTICULTURE

J. H. GOURLEY, M. S., *Chief*
W. J. GREEN, *Consulting Horticulturist*
PAUL THAYER, M. S., *Associate*
F. H. BALLOU, *Assistant* (Newark)
J. B. KEIL, *Field Assistant*
I. P. LEWIS, B. S., *Field Assistant*
C. W. ELLENWOOD, *Field Assistant*

SOILS

CHAS. E. THORNE, M. S. A., *Chief*
J. W. AMES, M. S., *Asso. in soil chemistry*
F. E. BEAR, Ph. D., *Associate*[1]
A. BONAZZI, B. Agr., *Assistant*
G. W. CONREY, A. M., *Assistant*[1]

FARM MANAGEMENT

C. W. MONTGOMERY, *Chief*
G. M. DEGROFT, *Assistant*
F. D. ECHELBERRY, B. S., *Office Assistant*

DISTRICT EXPERIMENT FARMS

Northeastern Test-Farm, Strongsville
D. S. KIRBY, *Foreman*

Southwestern Test-Farm, Germantown
HENRY M. WACHTER, *Manager*

Southeastern Test-Farm, Carpenter
E. C. SCHWAN, *Foreman*

Northwestern Test-Farm, Findlay
JOHN A. SUTTON, *Manager*

COUNTY EXPERIMENT FARMS

Miami Co. Experiment Farm, Troy
Madison Co. Experiment Farm, London
H. W. ROGERS, *Supt.*, London

Paulding Co. Experiment Farm, Paulding
H. R. HOYT, *Supt.*, Wooster

Clermont Co. Experiment Farm, Owensville
Hamilton Co. Experiment Farm, Mt. Healthy
W. E. WEAVER, *Supt.*, Mt. Healthy

Washington Co. Experiment Farm, Fleming
Washington Co. Truck Experiment Farm, Marietta
S. C. HARTMAN, M. S., *Supt.*, Marietta

Mahoning Co. Experiment Farm, Canfield
Trumbull Co. Experiment Farm, Cortland
J. PAUL MARKLEY, *Supt.*, Canfield

Belmont Co. Experiment Farm, St. Clairsville
C. W. MONTGOMERY, *Acting Supt.*, Wooster

STATE FORESTS

Waterloo State Forest, New Marshfield
Dean State Forest, Steece

---

[1]In cooperation with the College of Agriculture, Ohio State University, Columbus.
[2]In cooperation with the U. S. Department of Agriculture.

CONTENTS

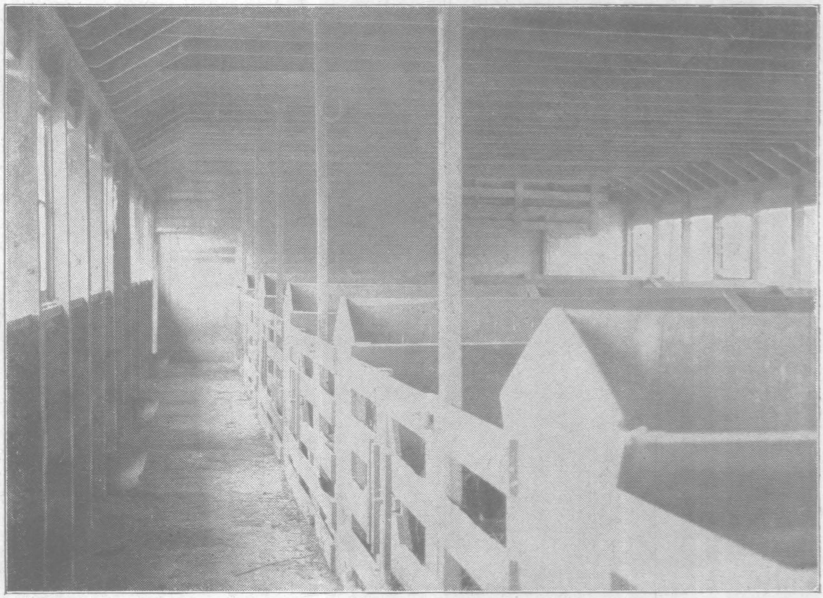

Fig. 2.—Interior view of feeding shed in which experiments were conducted at the Southeastern Test Farm, Carpenter

BULLETIN
OF THE
Ohio Agricultural Experiment Station
NUMBER 358 MAY, 1922

WINTER RATIONS FOR BREEDING EWES

J W. HAMMOND

The sheep breeder who is concerned with economic production has a vital interest in the problem of securing a cheap and efficient roughage or combination of roughages for wintering his breeding ewes. Since successful sheep raising depends to such a great extent upon the manner in which the ewes are fed during the winter, and especially while suckling their lambs, efficiency should not be sacrificed for the sake of economy. On most Ohio farms on which proper rotations are followed, the roughages most commonly available for sheep feeding are clover or alfalfa hay, corn stover and corn silage, and frequently oat straw. The experiments reported in this bulletin were planned for securing data which might indicate the best combinations of these roughages from the standpoint of both efficiency and economy, and to secure some information on the amount of protein supplement necessary properly to supplement these roughages.

Experiments with breeding females constitute a much more difficult undertaking than do experiments with fattening animals. In case of fattening animals, the efficiency of the ration may readily be measured by the rate of gain, the amount and cost of the feed required to produce a given amount of gain, and the condition of the animals at the close of the experiment. The efficiency of rations for breeding ewes, however, is determined by a larger number of factors, some of which cannot be measured accurately. The production of strong, vigorous lambs and the ability to suckle them so as to produce rapid growth are the objects most desired, consequently the efficiency of rations for breeding ewes is determined by these factors which can be measured only with difficulty and then not always exactly, as well as by the cost of the ration, the gains produced by the ewes and the thrift of the ewes during the experiment, another factor which cannot be measured with accuracy.

The experiments reported in this bulletin were conducted at the Southeastern Test Farm at Carpenter, Ohio. Much credit for the successful conduct of these experiments is due to the efforts of the shepherd, E. C. Schwan.

EXPERIMENTS I, II AND III

OBJECT

These experiments were planned to show comparisons of different combinations of corn, linseed meal, clover hay and corn silage. The principal comparisons made in the experiments were as follows:

1. Corn, linseed meal and silage vs. corn, linseed meal, clover hay and silage. Compare Lot 5 with Lots 3 and 4.
2. Corn, clover hay and silage vs. corn, linseed meal, clover hay and silage. Compare Lot 2 with Lots 3 and 4, and Lot 2-a with Lots 3-a and 4-a.
3. Different amounts of linseed meal as a supplement to corn silage fed in connection with corn and clover hay. Compare Lots 3 and 4 and Lots 3-a and 4-a.
4. Corn and clover hay vs. corn, linseed meal, clover hay and corn silage. Compare Lot 1 with Lots 3 and 4.
5. Incidentally the experiment afforded a comparison of ewes raising their first lambs and older ewes. Compare Lots 2, 3 and 4 with Lots 2-a, 3-a and 4-a, respectively.

PLAN OF EXPERIMENT

Table I shows the plan of the three experiments with respect to the period over which each extended, the number of ewes in each lot at the beginning of each experiment, and the rations fed. Not all of the rations were fed in all three experiments. A few of the ewes died during the progress of each experiment or were removed from the lots, as is shown in Table V.

Sheep used.—Each lot contained a few purebred Merino ewes. and with the exception of the two-year-old ewes, each lot also contained a few (from 2 to 4) crossbred ewes produced by crossing Southdown rams on Merino ewes. A large majority of the ewes, however, contained little, if any, other than Merino blood, although they were not eligible to registry. The Merino ewes were all of the C or light B type. Aside from the lots of two-year-old ewes, the ewes in Experiment I ranged in age from 3 to 7 years, those in Experiment II from 3 to 8 years, and those in Experiment III from 3 to 9 years, the greater part of them ranging from 3 to 6 years. In Experiment I, about one-half of the ewes were bred to Southdown rams and one-half to Merino rams. In Experiment II, about 75

percent of the older ewes were bred to Southdown rams and the remainder, as well as all of the two-year-old ewes, were bred to Merino rams. In Experiment III about 80 percent of the ewes were bred to Southdown rams and the remainder to Merino rams. In making up the lots great care was exercised to have all lots as nearly alike as possible with respect to age, weight, breeding, and to the rams to which the ewes were bred.

TABLE I.—PLAN OF EXPERIMENT

Experiment I. 95 days, December 12, 1913 to March 16, 1914, inclusive.

Old ewes					Two-year-old ewes		
		Lot 3 29 ewes Corn, linseed meal (light) clover* and silage	Lot 4 28 ewes Corn, linseed meal (heavy) clover* and silage	Lot 5 29 ewes Corn, linseed meal and silage		Lot 3—A 30 ewes Corn, linseed meal (light) clover* and silage	Lot 4—A 29 ewes Corn, linseed meal, clover* and silage

Experiment II. 124 days, December 10, 1914 to April 12, 1915, inclusive.

Old ewes					Two-year-old ewes		
	Lot 2 27 ewes Corn, clover and silage	Lot 3 27 ewes Corn, linseed meal (light), clover and silage	Lot 4 27 ewes Corn, linseed meal (heavy), clover and silage	Lot 5 27 ewes Corn, linseed meal and silage		Lot 3—A 14 ewes Corn, linseed meal, (light), clover and silage	Lot 4—A 14 ewes Corn linseed meal (heavy), clover and

Experiment III. 126 days, December 10, 1915 to April 13, 1916, inclusive.

Old ewes					Two-year-old ewes		
Lot 1 23 ewes Corn and clover	Lot 2 24 ewes Corn, clover and silage	Lot 3 24 ewes Corn, linseed meal (light), clover and silage	Lot 4 23 ewes Corn, linseed meal (heavy), clover and silage	Lot 5 22 ewes Corn, linseed meal and silage	Lot 2-A 13 ewes Corn, clover and silage	Lot 3—A 12 ewes Corn, linsed meal (light), clover and silage	Lot 4—A 13 ewes Corn, linseed meal (heavy), clover and silage

*Hay consisted partly of alfalfa, soybean and mixed hay (See Table IX).

Notwithstanding the precautions taken to prevent it, a few ewes that were not with lamb were included in the experiment. As soon as any ewes were discovered not to be with lamb they were removed from the experiment, as were also any ewes whose lambs had died.

Feeds used.—The corn used was purchased at intervals during each experiment and for the most part was of good quality. The corn silage was made from corn raised on the Southeastern Test Farm. The corn used for the silage was a variety that matures well in that locality and was allowed to become well-matured before it was put into the silo. The silage used, therefore, doubtless contained a larger proportion of grain and smaller proportion of water than does silage made from larger and later maturing varieties of

corn. The clover hay used in the experiments was shipped in and was of good quality. It consisted mainly of the medium red variety with a mixture of a little alsike and timothy. An attempt was made to get hay that was as nearly free as possible from timothy and other grasses. In Experiment I the hay consisted of approximately 50 percent clover hay and approximately 16⅔ percent each of alfalfa, soybean and mixed hay, all of good quality. (See Table IX).

Method of feeding.—The grain and silage were fed in two approximately equal portions, morning and evening, the silage being placed in the grain troughs and the corn and linseed meal sprinkled over it. In Lot 1, Experiment III, the hay was fed morning and evening after the grain was eaten. In all the other lots the hay was fed at noon to make possible the separate recovery of the refuse from each kind of roughage. All refused roughage was collected in bags each day and was weighed weekly.

All lots fed hay and silage were fed the same average amount of hay daily per head in each experiment, and were fed as much silage as the ewes would consume. All lots in each experiment were fed the same average amount of total concentrates daily per head, aside from the corn contained in the silage, with the exception of Lot 1 in Experiment III, which was fed more corn to compensate for the corn in the silage fed to the other lots. Lots 3 and 3-A were fed approximately 1 pound of linseed meal for every 30 pounds of silage fed and Lots 4 and 4-A were fed approximately, 1 pound of linseed meal for every 10 pounds of silage fed. Lot 5 was fed all the silage the ewes would consume and was fed approximately 1 pound of linseed meal for every 15 pounds of silage fed. Lot 1 was fed all the hay the ewes would consume. Table II shows the amounts and proportions of the feeds consumed.

By the time the experiments closed not enough of the lambs were old enough to justify feeding them by themselves, as was done in later experiments reported in this bulletin. It is possible that a few of the older lambs ate a small amount of feed, along with the ewes.

Weights.—The initial and final weights of the ewes were secured by averaging three weights taken on successive days. The ewes were weighed weekly during the experiment. All weights were taken in the morning before feed and water were given. Water was withheld during the night before the weights were taken.

All ewes and lambs were weighed individually at lambing time, the weights being taken after the lambs had dried off. Lambs

born during the night were weighed the next morning. The ewes and lambs were again weighed individually when the lambs were 10 days old.

Quarters.—Lots 1 to 5, inclusive, were housed in a one-story feeding shed extending east and west and affording good light and ventilation. Each lot was confined to a pen 12 feet by 19 feet, including rack space, and an outside lot 12 feet by 36 feet, on the south side of the shed. Lot 3-A and 4-A in Experiment I were housed in a shed similar to that occupied by Lots 1 to 5, with the exception that the pens were 12 feet by 20 feet and the outside lots were on the north side of the shed. In Experiments II and III, Lots 2-A, 3-A and 4-A were housed in pens 10 feet by 14 feet on the south side of the main sheep barn. These lots did not have access to outside lots.

The lots were all provided with combination feed racks, with a grain trough at the bottom and a V shaped hay rack above, so attached that any chaff or other fine particles of hay which worked through between the slats would fall into the grain trough. The sides of the rack were made solid far enough down to prevent chaff from working into the fleeces.

Water, salt and bedding.—Water was kept before the ewes at all times, except at night before weighing, in automatically regulated, galvanized iron tanks. The water was pumped from a deep well and was stored in an underground cistern on a hill above the barn so that it flowed into the tanks by gravity. Common barrel salt was kept before the ewes at all times. The pens were kept well bedded with wheat straw.

FEED CONSUMED

Table II shows the average amount of concentrates (aside from the grain contained in the silage), silage and total roughage consumed daily per head and the proportion of roughage and concentrates consumed for each four-week period. Table II also shows the average amount of each feed consumed daily per head for the entire experiment, the proportion of concentrates and roughage consumed, the percent of the hay and silage consumed, and the number of pounds of silage fed and consumed for each pound of linseed meal consumed. In Table II and throughout this bulletin the term "roughage" has reference to the weight of the hay plus one-third of the weight of the silage, on the basis that three pounds of silage contain approximately the same amount of dry matter as one pound of hay.

TABLE II.—AVERAGE DAILY RATION CONSUMED, RATIO BETWEEN CONCENTRATES AND ROUGHAGE CONSUMED AND PERCENT OF ROUGHAGES CONSUMED

Experiment I. 95 days, December, 12, 1913 to March 16, 1914, inclusive.

Period		Old ewes			Two-year-old ewes	
		Lot 3	Lot 4	Lot 5	Lot 3—A	Lot 4—A
I 27 days	Total concentrates .....pounds..	.61	.60	.60	.60	.61
	Silage.....pounds..	3.45	3.43	4.27	2.90	2.89
	Total roughage†... . .....pounds..	1.65	1.62	1.42	1.44	1.43
	Concentrates, 1; roughage† ..pounds..	2.68	2.70	2.37	2.40	2.38
II 28 days	Total concentrates.....pounds..	.60	.60	.60	.60	.60
	Silage.....pounds..	3.39	3.57	4.36	2.70	2.75
	Total roughage†.....pounds..	1.60	1.66	1.45	1.38	1.39
	Concentrates, 1; roughage† ..pounds..	2.66	2.77	2.40	2.30	2.29
III 28 days	Total concentrates.....pounds..	.63	.63	.63	.62	.63
	Silage..... ....pounds..	3.02	3.30	3.73	2.53	2.65
	Total roughage†.....pounds..	1.48	1.56	1.24	1.30	1.35
	Concentrates, 1; roughage† ..pounds..	2.35	2.49	1.98	2.01	2.15
IV. 12 days	Total concentrates.....pounds..	.78	.75	.75	.78	.75
	Silage..... ....pounds..	2.95	3.15	3.53	2.69	2.80
	Total roughage†..... ...pounds..	1.43	1.50	1.18	1.32	1.36
	Concentrates, 1; roughage† ..pounds..	1.83	2.00	1.57	1.68	1.82
Total 95 days	Corn .....pounds..	.51	.30	.31	.53	.36
	Linseed meal.....pounds..	.12	.33	.32	.10	.27
	Total concentrates..... ....pounds..	.63	.63	.63	.63	.63
	Hay*..... ....pounds.	.47	.47	.....	.47	.46
	Silage.....pounds..	3.25	3.40	4.06	2.71	2.77
	Total roughage†.....pounds..	1.55	1.60	1.35	1.37	1.38
	Total feed.....pounds..	2.18	2.23	1.98	2.00	2.01
	Concentrates, 1; roughage† ..pounds..	2.46	2.56	2.16	2.19	2.21
	Percent hay consumed.....pounds .	94.16	93.24	.....	93.20	92.83
	Percent silage consumed.....pounds .	96.16	98.46	96.89	96.76	97.68
	Silage fed per pound linseed meal consumed.....pounds .	28.09	10.48	13.00	27.72	10.38
	Silage consumed per pound linseed meal consumed.....pounds..	27.01	10.32	12.59	26.83	10.14

*See Table IX p. 145 for the amount of the different kinds of hay fed.
†Hay plus one-third of weight of silage. See p. 132 for explanation.

TABLE II.—AVERAGE DAILY RATION CONSUMED, RATIO BETWEEN CONCENTRATES AND ROUGHAGES CONSUMED AND PERCENT OF ROUGHAGES CONSUMED—(Continued)

Experiment II. 124 days, December 10, 1914 to April 12, 1915, inclusive.

Period		Old ewes				Two-year-old ewes	
		Lot 2	Lot 3	Lot 4	Lot 5	Lot 3—A	Lot 4—A
I 28 days	Total concentrates ....pounds..	.40	.40	.40	.40	.40	.40
	Silage.....pounds..	3.39	3.43	3.43	4.54	3.13	3.16
	Total roughage†.....pounds..	1.86	1.87	1.87	1.51	1.76	1.77
	Concentrates, 1; roughage†..pounds..	4.65	4.72	4.70	3.79	4.46	4.45
II 28 days	Total concentrates.....pounds..	.40	.40	.40	.40	.39	.39
	Silage.....pounds..	3.43	3.50	3.52	4.51	3.11	3.19
	Total roughage†.....pounds..	1.85	1.88	1.88	1.50	1.72	1.75
	Concentrates, 1; roughage†..pounds..	4.58	4.60	4.72	3.72	4.37	4.47
III 28 days	Total concentrates..... pounds.	.42	.43	.41	.42	.42	.42
	Silage.....pounds..	3.27	3.48	3.67	4.23	2.96	3.17
	Total roughage†.....pounds..	1.78	1.86	1.92	1.41	1.67	1.73
	Concentrates, 1; roughage†..pounds..	4.19	4.37	4.67	3.32	4.00	4.16
IV 28 days	Total concentrates .....pounds..	.60	.60	.60	.60	.61	.61
	Silage.....pounds..	3.14	3.50	3.70	3.87	2.76	3.19
	Total roughage†.....pounds..	1.76	1.88	1.94	1.29	1.58	1.74
	Concentrates, 1; roughage†..pounds..	2.95	3.13	3.23	2.15	2.61	2.88
V 12 days	Total concentrates .....pounds..	.75	.75	.76	.75	.75	.75
	Silage.....pounds..	3.21	3.51	3.70	4.37	2.84	3.21
	Total roughage†.....pounds..	1.80	1.90	1.96	1.46	1.67	1.80
	Concentrates, 1; roughage†..pounds..	2.40	2.54	2.59	1.94	2.22	2.40
Total 124 days	Corn .....pounds..	.48	.37	.12	.19	.38	.16
	Linseed meal.....pounds..	.....	.12	.36	.29	.10	.32
	Total concentrates.....pounds..	.48	.49	.48	.48	.48	.48
	Clover hay.....pounds..	.71	.71	.71	.....	.69	.69
	Silage.....pounds..	3.30	3.48	3.59	4.30	2.97	3.18
	Total roughage†.....pounds..	1.81	1.86	1.91	1.43	1.68	1.75
	Total feed.....pounds..	2.30	2.35	2.39	1.92	2.16	2.23
	Concentrates, 1; roughage† ..pounds..	3.74	3.86	3.97	2.97	3.49	3.64
	Percent hay consumed.....pounds..	94.94	95.36	95.24	.....	91.78	92.70
	Percent silage consumed.....pounds..	97.66	99.42	99.81	97.74	96.92	95.56
	Silage fed per pound linseed meal consumed..... ...pounds..	.....	29.16	10.05	15.00	30.66	10.35
	Silage consumed per pound linseed meal consumed.....pounds..	.....	28.99	10.04	14.66	29.72	9.89

†Hay plus one-third of weight of silage fed. See p. 132 for explanation.

TABLE II.—AVERAGE DAILY RATION CONSUMED, RATIO BETWEEN CONCENTRATES AND ROUGHAGE CONSUMED AND PERCENT OF ROUGHAGES CONSUMED—(Concluded)

Experiment III. 126 days. December 10, 1915 to April 13, 1916, inclusive.

Period		Old ewes					Two-year-old ewes		
		Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 2—A	Lot 3—A	Lot 4—A
I 27 days	Total concentrates ... pounds..	.45	.38	.38	.39	.38	.39	.38	.39
	Silage pounds..	....	3.08	3.12	3.38	3.98	2.82	2.82	2.85
	Total roughage pounds..	2.05	1.82	1.82	1.91	1.33	1.72	1.73	1.73
	Concentrates, 1; roughage* pounds..	4.54	4.77	4.78	4.91	3.47	4.44	4.52	4.45
II 28 days	Total concentrates pounds..	.47	.40	.40	.40	.40	.40	.40	.40
	Silage pounds..	.....	3.30	3.29	3.85	4.40	3.20	3.43	3.56
	Total roughage* pounds..	2.44	1.82	1.82	2.00	1.50	1.79	1.86	1.91
	Concentrates, 1; roughage* pounds.	5.22	4.57	4.59	4.97	3.76	4.43	4.71	4.71
III 28 days	Total concentrates pounds..	.57	.45	.44	.45	.45	.45	.44	.45
	Silage pounds..	.....	3.02	3.23	3.81	3.89	3.00	3.64	3.76
	Total roughage* pounds..	2.51	1.82	1.80	1.97	1.39	1.71	1.91	1.96
	Concentrates, 1; roughage* pounds..	4.43	3.85	4.04	4.41	2.91	3.82	4.31	4.37
IV 28 days	Total concentrates pounds.	.68	.53	.53	.53	.53	.53	.53	.53
	Silage pounds..	...	2.74	3.19	3.88	3.45	2.88	3.67	3.77
	Total roughage* pounds.	2.60	1.64	1.79	2.01	1.15	1.68	1.93	1.96
	Concentrates, 1; roughage* pounds..	3.81	3.09	3.38	3.79	2.16	3.16	3.62	3.69
V 15 days	Total concentrates pounds	.75	.60	.59	.60	.60	.60	.60	.60
	Silage pounds	....	2.36	2.96	3.73	3.45	2.84	3.68	3.81
	Total roughage* pounds.	2.72	1.52	1.73	1.97	1.15	1.67	1.94	2.00
	Concentrates, 1; roughage* pounds.	3.62	2.55	2.90	3.31	1.93	2.80	3.23	3.36
Total 126 days	Corn pounds..	.57	.46	.35	.08	.19	.46	.34	.10
	Linseed meal pounds..	...	.....	.11	.38	.27	.....	.12	.36
	Total concentrates pounds..	.57	.46	.46	.46	.46	.46	.46	.46
	Clover hay pounds	2.44	.74	.74	.73	....	.73	.73	.73
	Silage pounds.	.....	2.96	3.18	3.73	3.89	2.96	3.43	3.53
	Total roughage* pounds..	2.44	1.73	1.80	1.97	1.30	1.72	1.87	1.90
	Total feed pounds.	3.01	2.18	2.25	2.43	1.76	2.18	2.33	2.37
	Concentrates, 1; roughage* pounds..	4.30	3.76	3.95	4.30	2.91	3.73	4.08	4.12
	Percent hay consumed pounds.	96.17	96.61	96.24	94.97	.....	95.97	95.07	95.21
	Percent silage consumed pounds..	.....	94.56	97.06	98.37	96.38	95.38	97.76	98.44
	Silage fed per pound linseed meal consumed pounds..	.....	.....	29.36	9.98	14.91	.....	30.21	10.00
	Silage consumed per pound linseed meal consumed pounds..	...	.....	28.50	9.82	14.37	.....	29.54	9.74

*Hay plus one-third of silage fed. See p. 132 for explanation.

WEIGHTS AND GAINS

Table III shows the initial and final weight, the number and weight of the ewes that died during the experiment, the weight of the lambs born during the experiment, and in Experiments II and III the weight of wool produced by the ewes remaining in each lot at the time they were shorn. In Experiment I the ewes were not shorn until after the close of the experiment, consequently the wool produced need not be considered in this table. The total gain for each lot, as shown in Table III was secured by adding the weight of the lambs born, the weight of the ewes that died or were removed, and in Experiments II and III, the weight of the wool produced, to the final weight of the ewes in the lot at the close of the experiment, and subtracting from this weight the initial weight of the ewes. Since the birth weight of the lamb by no means represents the loss in weight of the ewe during lambing, the total gain as shown in Table III does not show the entire increase in live weight made by the ewes during the experiment. Since there is no practical method of determining the loss in weight during lambing, the exact amount of gain produced cannot be ascertained.

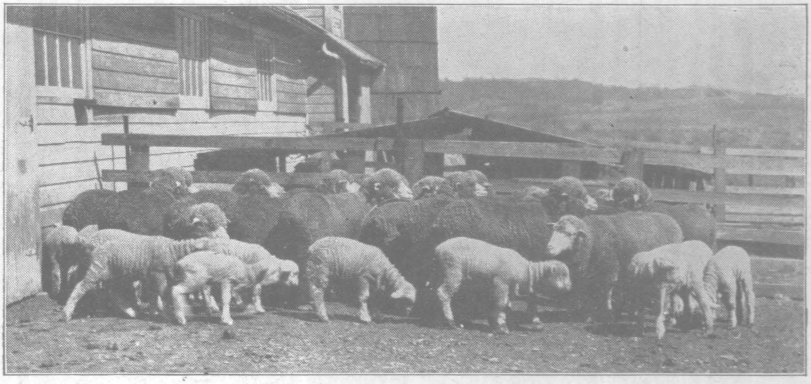

Fig. 3.—Lot 1 in Experiment V. Ewes fed corn and alfalfa

Although the efficiency of rations for breeding ewes is best measured by other things than the increase in live weight by the ewes, the average daily gain per ewe, as shown by Table III, is of interest.

Table IV shows the average weight at birth and at 10 days of age, of all lambs born during the experiment. A few lambs born after the close of the experiments were not included in this table.

For Experiment III, Table IV also shows the age and weight of the lambs at the close of the experiment and the average daily gain

TABLE III.—WEIGHTS AND GAINS—EWES

	Lot 1 Corn and clover	Lot 2 Corn, clover and silage	Lot 3 Corn, linseed meal (light), clover and silage	Lot 4 Corn, linseed meal (heavy), clover and silage	Lot 5 Corn, linseed meal and silage	Lot 2—A Corn, clover and silage	Lot 3—A Corn, linseed meal (light), clover and silage	Lot 4—A Corn, linseed meal (heavy), clover and silage
Experiment I. 95 days, December 12, 1913 to March 16, 1914, inclusive.								
			Pounds	*Pounds*	*Pounds*		*Pounds*	*Pounds*
Initial weight, December 11, 12, 13			2,570	2,448.5	2,598.5		2,431.5	2,285
Final weight, March 16, 17, 18			2,352.5	2,446.5	2,340.5		2,033.5	2,280.5
Ewes removed			(3) 330	(2) 162.5	(4) 440		(6) 482.5	(3) 210
Ewes died			(1) 115	(1) 85.	(1) 90			
Lambs born*			155	175.	141.25		153.5	127.5
Total gain†			382.5	420.5	413.25		339.	333.
Average daily gain per head			.142	.142	.154		.123	.123
Experiment II. 124 days, December 10, 1914 to April 12, 1915, inclusive.								
		Pounds						
Initial weight, December 9, 10, 11		2,475	2,432	2,447	2,432		1,217	1,193
Final weight, April 12, 13, 14		2,100	2,362	2,372	2,163		1,197.5	1,200
Ewes died		(1) 90			(2) 195			
Lambs born*		251.25	239.5	250.25	193.5		96.	124
Wool shorn		214.4	236.	225.9	209.2		141.	137.4
Total gain‡		180.65	405.5	401.15	328.7		217.5	268.4
Average daily gain per head		.056	.121	.120	.102		.125	.155
Experiment III. 126 days, December 10, 1915 to April 13, 1916, inclusive.								
	Pounds					*Pounds*		
Initial weight, December 9, 10, 11	2,032	2,135	2,108	2,012	1,910	1,182	1,078	1,186
Final weight, April 13, 14, 15	1,813	1,635	1,830	1,663	1,455	987	1,008	1,067
Ewes died		(2) 143		(2) 165	(1) 52			
Lambs born*	221.	201.75	202.75	165.75	164.75	101.75	88.5	106.75
Wool shorn	181.5	180.	189.	174.	159.75	115.75	109.5	122.25
Total gain‡	183.5	24.75	113.75	155.75	—78.5	22.5	128.	109.
Average daily gain per head	.063	.008	.038	.056	—.028	.014	.085	.067

*Includes only weight of lambs born before close of the experiment.
†Includes the weight of the lambs born during the experiment.
‡Includes the weight of the lambs born during the experiment and the weight of the wool shorn.

TABLE IV.—AVERAGE WEIGHTS AND GAINS—LAMBS

	Lot 1 Corn and clover		Lot 2 Corn, clover, and silage		Lot 3 Corn, linseed meal (light), clover and silage		Lot 4 Corn, linseed meal (heavy), clover and silage		Lot 5 Corn, linseed meal and silage		Lot 2—A Corn, clover and silage		Lot 3—A Corn, linseed meal (light) clover and silage		Lot 4—A Corn, linseed meal (heavy), clover and silage	
Experiment I. 95 days, December 12, 1913, to March 16, 1914, inclusive.																
					No.	*Pounds*	*No.*	*Pounds*	*No.*	*Pounds*			*No.*	*Pounds*	*No.*	*Pounds*
Average weight at birth: Singles....pounds..					24	8.52	22	8.98	20	8.4	....	.....	25	7.74	24	7.58
Twins....pounds..					2	6.75	4	6.12	10	6.28	....	.....	....	.....	2	8.
Average weight at 10 days of age‡: Singles..pounds..					6	12.62	5	14.19	6	12.08	...	.....	7	11.71	6	12.75
Twins...pounds..					....	.....	....	.....	2	8.	...	.....	....	.....	2	12.25
Experiment II. 124 days, December 10, 1914 to April 12, 1915, inclusive.																
			No.	*Pounds*												
Average weight at birth: Singles....pounds..			20	9.11	21	8.71	21	9.24	17	9.57	....	.....	13	7.69	10	8.3
Twins....pounds..			10	6.9	8	7.06	8	7.03	6	5.12	....	.....	2	6.	6	6.83
Average weight at 10 days of age‡: Singles..pounds..			18	12.92	21	12.82	19	13.91	17	13.5	...	.....	10	11.55	8	11.5
Twins...pounds..			7	10.07	4	11.37	8	10.25	1	12.	...	.....	2	9.75	5	9.9
Experiment III. 126 days, December 10, 1915 to April 13, 1919, inclusive.																
	No.	*Pounds*									*No.*	*Pounds*				
Average weight at birth: Singles....pounds..	19	9.	15	8.95	21	8.74	17	9.75	20	8.64	10	8	11	8.05	11	8.30
Twins....pounds..	8	6.25	10	6.75	6	6.79	....	.....	....	.....	4	5.44	....	.....	2	7.75
Average weight at 10 days of age: Singles...pounds..	18	13.	14	11.59	18	12.79	17	13.54	20	12.05	9	11.22	11	11.73	10	13.
Twins....pounds..	8	9.5	8	9.53	4	9.	....	.....	....	.....	3	6.83	....	.....	....	.....
Average weight at close of experiment*: Singles....pounds..	17	19.5	13	17.73	17	20.59	17	23.76	18	18.44	9	16.67	10	18.55	10	21.1
Twins....pounds..	7	16.72	7	13.56	3	13.33	....	.....	....	.....	2	10.25	....	.....	....	.....
Average age at close of experiment*: Singles.pounds..	17	33.53	13	33.08	17	35.94	17	37.76	18	36.39	9	35.89	10	30.1	10	33.4
Twins..pounds..	7	38.43	7	38.71	3	38.67	....	.....	...	.....	2	27.	....	.....	....	.....
Average daily gain during experiment†: Singles....pounds..	17	.315	13	.266	17	.328	17	.371	18	.263	9	.238	10	.346	10	.387
Twins....pounds..	7	.272	7	.177	3	.164	....	.....	....	.....	2	.208	....	.....	....	.....

*Does not include weights of a few lambs changed from one lot to another because of death of their dams; hence more lambs were raised in some lots than are shown by the figures. (See Table V).

†Exclusive of weight at birth.

‡Includes only those lambs which were 10 days old at the close of the experiment.

TABLE V.—NUMBER OF LAMBS RAISED IN EACH LOT

	Old ewes					Two-year-old ewes		
	Lot 1 Corn and clover	Lot 2 Corn, clover and silage	Lot 3 Corn, linseed meal (light), clover and silage	Lot 4 Corn, linseed meal (heavy), clover and silage	Lot 5 Corn, linseed meal and silage	Lot 2—A Corn, clover and silage	Lot 3—A Corn, linseed meal (light), clover and silage	Lot 4—A Corn, linseed meal (heavy), clover and silage
Experiment I. 1913-14								
Lambs born during experiment			18	20	17		20	17
Lambs born after close of experiment			8	6	13		5	9
Lambs died during experiment			1	2	1		2	2
Lambs removed					1			
Lambs added								
Lambs in lot at close of experiment			17	18	15		18	15
Ewes not with lamb			2					
Experiment II. 1914-15								
Lambs born during experiment		30	29	29	23		13	16
Lambs born after close of experiment			1				2	
Lambs died during experiment		6	3	2	5		1	2
Lambs removed			2	1				
Lambs added		2		2				
Lambs in lot at close of experiment		26	24	28	18		12	14
Ewes not with lamb		1						
Experiment III. 1915-16								
Lambs born	27	25	27†	17	20	15‡	11	13
Lambs died during experiment	1	4	4		2	3	1	3
Lambs removed	1	1	1			1		
Lambs added			1			1		1
Lambs in lot at close of experiment	25	20	21	17	18	12	10	11
Ewes not with lamb		4		5	2*		1	1

*One of these two ewes aborted.
†Two lambs born after close of experiment.
‡One lamb born after experiment closed, but died when a few days old.

per lamb during the experiment. These items are not given for Experiments I and II because the most of the lambs were born shortly before the close of the experiment. The weight of the lamb at birth was not included in calculating the average daily gain per head. On a few occasions a lamb whose mother had died or was unable to suckle it was transferred to a ewe in another lot whose lamb had died. Lambs thus transferred were not included in any calculations after they were transferred. For this reason Table IV does not show the total number of lambs raised in all lots. This information is given in Table V. In Table IV, the average weights for single and twin lambs are given separately. When a twin lamb died, its mate was still regarded as a twin in all later calculations.

Fig. 4.—Lot 2 in Experiment V. Ewes fed corn, cottonseed meal and silage

Fig. 5.—Lot 3 in Experiment V. Ewes fed corn and cottonseed meal every other day corn, cottonseed meal, alfalfa and silage on alternating days

LAMBS RAISED

Table V shows the number of lambs born in each lot, the number of lambs added to each lot, the number that died, the number removed and the number remaining in each lot at the close of the experiment. The table also shows the number of ewes in each lot that did not have lambs.

VIGOR AND CONDITION OF LAMBS

Table VI shows the vigor and condition of the lambs at birth. Twin lambs are not included in this table. Table VI was made up from careful records made by the shepherd in charge at lambing time. Such characters as vigor and condition can be measured arbitrarily only, but since the records were carefully made by the same person in all three experiments, they doubtless show a high degree of accuracy.

TABLE VI.—VIGOR AND CONDITION OF LAMBS

Lot	Vigor			Condition		
	Weak	Average	Strong	Thin	Average	Fat
			Experiment I. 1913-14			
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
3	8.33	33.33	58.34	12.50	58.33	29.17
4	.....	19.05	80.95	4.76	33.33	61.91
5	.....	47.37	52.63	5.26	68.42	26.32
3—A	8.70	39.13	52.17	8.70	56.52	34.78
4—A	12.5	37.50	50.00	25.00	54.17	20.83
			Experiment II. 1914-15			
2	.....	5.56	94.44	5.56	61.11	33.33
3	.....	23.81	76.19	4.76	71.43	23.81
4	.....	5.00	95.00	....	45.00	55.00
5	.....	5.88	94.12	.....	35.29	64.71
3—A	7.69	23.08	69.23	15.38	69.24	15.38
4—A	.....	20.00	80.00	.....	70.00	30.00
			Experiment III. 1915-16			
1	.....	26.32	73.68	.. ..	36.84	63.16
2	.....	26.67	73.33	.....	46.67	53.33
3	.....	16.67	83.33	5.56	16.67	77.77
4	.....	5.88	94.12	.....	41 18	58.82
5	5.	20.00	75.00	5.00	40.00	55.00
2—A	10.	50.00	40.00	.....	70.00	30.00
3—A	.....	63.64	36.36	.....	63.64	36.36
4—A	9.09	27.27	63.64	....	54.55	45.55

MILK FLOW AND CONDITION OF EWES AT LAMBING

Table VII shows the milk flow of the ewes and their condition at lambing time. These characters, like the vigor and condition of the lambs, were determined arbitrarily, though carefully, by the shepherd in charge at lambing time.

TABLE VII.—MILK FLOW AND CONDITION OF EWES

Lot	Milk flow				Condition		
	Poor	Average	Good	Extra good	Thin	Average	Fat
			Experiment I. 1913-14				
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
3	8.	12.	68.	12.	12.00	56.00	32.00
4	4.17	4.17	83.33	8.33	.....	29.17	70.83
5	12.5	4.17	83.33	.....	.....	62.50	37.50
3—A	8.33	33.33	58.34	.....	4.17	66.67	29.16
4—A	4.	32.00	64.	.....	4.00	56.00	40.00
			Experiment II. 1914-15				
2	16.	16.	52.	16.	.....	44.00	56.00
3	12.	8.	60.	20.	.....	56.00	44.00
4	4.	12.	52.	32.	.....	32.00	68.00
5	15.	10.	50.	25.	5.00	60.00	35.00
3—A	.....	28.57	71.43	.....	.....	42.85	57.14
4—A	.....	23.08	69.23	7.69	.....	.....	100.00
			Experiment III. 1915-16				
1	8.70	21.74	47.82	21.74	4.35	43.48	52.17
2	25.	30.	40.00	5.	10.00	45.00	45.
3	8.70	17.39	65.27	8.70	.....	60.87	39.13
4	11.76	17.65	35.29	35.29	17.65	17.65	64.70
5	5.	45.	50.00	.....	5.00	50.00	45.00
2—A	15.39	30.76	53.85	.....	.....	46 15	53.85
3—A	9.09	9.09	81.82	.....	.....	9.09	90.91
4—A	8.33	.....	41.67	50.00	.....	25.00	75.00

WOOL PRODUCED

The ewes were shorn on the last two days of March each year. A power driven shearing machine was used and all the ewes were shorn as nearly alike as possible. Each fleece was tied and weighed separately, care being taken to collect all locks from each fleece.

TABLE VIII.—WOOL PRODUCED BY EWES

	Lot 1 Corn and clover	Lot 2 Corn, clover and silage	Lot 3 Corn, linseed meal (light), clover and silage	Lot 4 Corn, linseed meal (heavy), clover and silage	Lot 5 Corn, linseed meal and silage	Lot 2—A Corn, clover and silage	Lot 3—A Corn, linseed meal (light), clover and silage	Lot 4—A Corn, linseed meal (heavy), clover and silage
				Experiment I. 1913-14				
Total....pounds..	.....	.....	244.1	244.2	242.2	.....	311.	293.
Average..pounds..	.....	.....	9.04	9.04	8.65	.....	10.37	9.77
				Experiment II. 1914-15				
Total....pounds..	.....	214.4	236.	225.9	209.2	.....	141.	137.4
Average..pounds..	.....	8.25	8.74	8.37	8.37	.....	10.07	9.81
				Experiment III. 1915-16				
Total . .pounds..	181.5	180.	189.	174.	159.75	115.75	109.5	122.25
Average..pounds..	7.9	7.8	7.9	8.3	7.3	8.9	9.1	9.4

Table VIII shows the total and average wool production for all the ewes in each lot in Experiment I. For Experiments II and III, Table VIII shows the total and average wool production for all the ewes remaining in the lots at shearing time. As may be seen from the table the ewes were rather light shearers. Lots 1 to 5, inclusive, contained a few ewes which were pretty well along in years and a few crossbred ewes which lowered the average wool production for these lots.

It would scarcely be expected that the rations fed for 100 to 125 days during the winter would exert any marked influence on the total wool production for the year unless there were greater differences between the rations than existed in these experiments. While Table VIII shows no marked or consistent differences in the average weight of wool produced per ewe, it does indicate that a ration in which corn silage constituted the sole roughage (Lot 5) had a tendency to produce lighter fleeces than the other rations fed.

COST OF RATIONS

In experiments of this nature there is no basis which makes possible a direct, accurate comparison of the economy of the rations fed, as is the case in experiments with fattening animals. In fattening experiments the efficiency of the rations is commonly measured by but two factors—the amount of increase in live weight produced by a given amount of feed and by the influence on the market value of the finished animals, both of which may be determined easily and with a high degree of accuracy. In experiments with breeding ewes, the chief but not the only measure of the efficiency of rations is the effect on the rate of growth of the lambs not only during the experiment but throughout the remainder of their lives. These are factors which cannot be measured or assigned definite values.

Perhaps the best basis for the comparison of rations, with respect to cost in these experiments is the average daily cost of the feed fed per ewe. Table IX makes possible such a comparison. It is improbable that the prices for feeds that have been used in this table will apply to a large number of cases, but the table makes it possible for the reader to apply his own prices.

TABLE IX.—TOTAL FEED FED TO EWES AND AVERAGE DAILY COST OF FEED PER HEAD

Experiment I. 95 days, December 12, 1913 to March 16, 1914, inclusive.

	Lot 3		Lot 4		Lot 5		Lot 3—A		Lot 4—A	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Corn at 70 cents per bushel	1,375	$17.19	752.	$ 9.40	824.9	$10.31	1,442.8	$18.03	960.	$12.00
Linseed meal at $36 per ton	329.3	5.93	838.9	15.10	863.25	15.54	277.4	4.99	737.5	13.27
Clover hay at $10 per ton	590.5	2.95	567.5	2.84	.....	.....	594.	2.97	598.	2.99
Alfalfa hay at $12 per ton	275.5	1.65	257.5	1.54	.....	.....	285.	1.71	275.5	1.65
Soybean hay at $10 per ton	246.5	1.23	231.5	1.16	.....	.....	255.	1.27	246.5	1.23
Mixed hay at $8 per ton	232.	.93	216.	.86	.....	.....	240.	.96	232.	.93
Silage at $4 per ton	9 081.5	18.16	8,791.	17.58	11,220.5	22.44	7,690.	15.38	7,657.	15.31
Total cost of feed	$48.04		$48.48		$48.29		$45.31		$47.38	
"Sheep days" in experiment	2,689		2,545		2,680		2,748		2,704	
Average daily cost of feed per ewe, cents	1.79		1.90		1.80		1.65		1.75	

Experiment II. 124 days, December 10, 1914 to April 12, 1915, inclusive.

	Lot 2		Lot 3		Lot 4		Lot 5		Lot 3—A		Lot 4—A	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Corn at 70 cents per bushel	1,569.	$19.61	1,226.5	$15.33	415.25	$ 5.19	610.	$ 7.62	662.25	$ 8.28	279.	$ 4.48
Linseed meal at $36 per ton	.....	.....	402.	7.24	1,198.25	21.56	941.5	16.95	173.75	3.13	558.	10.04
Clover hay at $10 per ton	2,430.25	12.15	2,511.	12.56	2,511.	12.56	.....	.....	1,302.	6.51	1,302.	6.51
Silage at $4 per ton	10,940.	21.88	11,723.	23.45	1,204.8	24.10	14,124.	28.25	5,327.5	10.66	5,775.5	11.55
Total cost of feed	$53.64		$58.58		$63.41		$52.82		$28.58		$31.58	
"Sheep days" in experiment	3,240		3,348		3 3.8		3 212		1,736		1,736	
Average daily cost of feed per head, cents	1.66		1.75		1.89		1.64		1.65		1.82	

TABLE IX.—TOTAL FEED FED TO EWES AND AVERAGE DAILY COST OF FEED PER HEAD—(Continued)

Experiment III. 126 days, December 10, 1915 to April 13, 1916, inclusive.

	Lot 1		Lot 2		Lot 3		Lot 4		Lot 5	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Corn at 70 cents per bushel	1,644.5	$20.56	1,343.75	$16.80	1,044.5	$13.06	219.25	$ 2.74	516.	$ 6.45
Linseed meal at $36 per ton					337.2	6.07	1,065.25	19.17	747.75	13.46
Clover hay at $10 per ton	7,351.	36.76	2,244.5	11.22	2,312.5	11.56	2,147.	10.73	91.	.45
Silage at $4 per ton			9,181.	18.36	9,902.	19.80	10,635.	21.27	11,146.	22.29
Total cost of feed	$57.32		$46.38		$50.49		$53.91		$42.65	
"Sheep days" in experiment	2,898		2,933		3,024		2,806		2,759	
Average daily cost of feed per head, cents	1.98		1.58		1.67		1.92		1.55	

	Lot 2—A		Lot 3—A		Lot 4—A	
	Pounds	Value	Pounds	Value	Pounds	Value
Corn at 70 cents per bushel	756.	$ 9.45	517.75	$ 6.47	169.25	$ 2.12
Linseed meal at $36 per ton			175.5	3.16	587.25	10.57
Clover hay at $10 per ton	1,252.	6.26	1,156.	5.78	1,252.	6.26
Silage at $4 per ton	5,081.	10.16	5,302.	10.60	5,872.	11.74
Total cost of feed	$25.87		$26.01		$30.69	
"Sheep days" in experiment	1,638		1,512		1,638	
Average daily cost of feed per head, cents	1.58		1.72		1.87	

CORN, LINSEED MEAL AND SILAGE VS. CORN, LINSEED MEAL, CLOVER AND SILAGE

Compare Lot 5 with Lots 3 and 4

With an increasing appreciation of the value of corn silage as a feed for sheep there is a temptation, when hay or other forms of dry roughage are scarce or high in price, to feed silage as the sole roughage to breeding ewes. This experiment was planned to make possible a comparison of a ration in which silage was the only roughage fed (Lot 5) with rations in which the silage was supplemented with clover hay (Lots 3 and 4). In Lot 5 the silage was supplemented with what was regarded as enough linseed meal to supply an adequate amount of protein in the ration. In Lots 3 and 4, the silage was supplemented with different amounts of protein to make possible a comparison discussed later in this bulletin. The amount of linseed meal fed to different lots is shown by Table II.

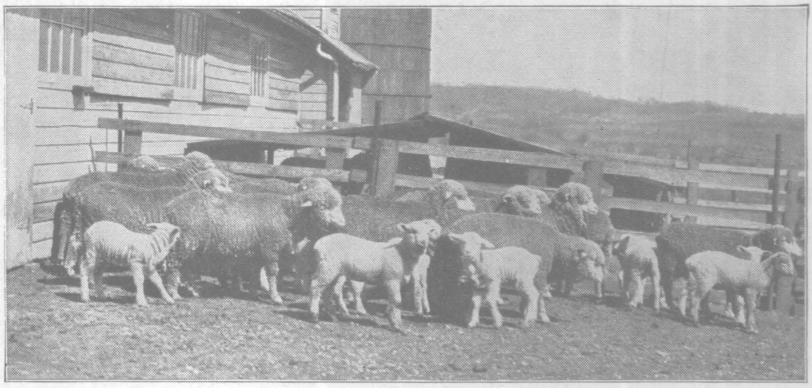

Fig. 6.—Lot 4 in Experiment V. Ewes fed corn and cottonseed meal and silage during first half of experiment and corn, cottonseed meal, alfalfa and silage during last half

Table II shows that the three lots consumed practically the same amount of concentrates per head in all three experiments. While Lot 5 consumed more silage than did Lots 3 and 4 the total consumption of roughage was smaller than it was in the two lots fed clover hay in addition to the silage. It is possible that this difference in the amount of total feed consumed is at least partly responsible for the difference in performance of the ewes and lambs that is noted in the following paragraphs of this discussion.

Table III shows that with one exception the ewes in Lot 5 fed silage as the sole roughage made smaller gains in all three experiments than did those in Lots 3 and 4, fed clover hay in addition to

the silage. Table VII indicates that in all three experiments the ewes in Lot 5 were in poorer condition at lambing time than were the ewes in Lots 3 and 4.

Table IV shows no consistent differences in the single lambs in Lots 3 and 4 and those in Lot 5 with respect to weight at birth and at 10 days of age. This table shows, however, that the single lambs in Lot 5 made a decidedly smaller average daily gain per head in Experiment III than did the lambs in Lots 3 and 4. This is doubtless due to the fact that the ewes in Lot 5 produced a less generous milk flow than did the ewes in Lots 3 and 4, as is indicated in Table VII. Table VI shows that with the exception of Lot 3 in Experiment II the lambs in Lots 3 and 4 surpassed those in Lot 5 in vigor and condition at birth.

Table VIII shows some evidence that a ration containing silage as the sole roughage for breeding ewes produced lighter fleeces than did rations containing both silage and clover hay.

The economy of feeding silage as the sole roughage to breeding ewes as compared with supplementing the silage with clover hay depends upon the relative prices of the feeds used as well as upon the results produced. Table IX shows that at the prices for feeds used in these experiments the addition of clover hay to a ration composed of corn, linseed meal and silage increased the average feed cost per ewe for the entire feeding period as follows:

Experiment	Days duration	Additional cost of feed for Lot 3 over Lot 5	Additional cost of feed for Lot 4 over Lot 5
1	95	$.	$ .09
2	124	.14	.31
3	126	.15	.47

The additional vigor and the higher condition of the lambs at birth as well as the greater gain produced would indicate that except with a great disparity in prices of hay and silage the slight additional cost of the ration would be more than offset by the greater value of the lambs produced by the ration containing clover hay in addition to the silage.

CORN, CLOVER AND SILAGE VS. CORN, CLOVER, SILAGE AND LINSEED MEAL

Compare Lot 2 with Lots 3 and 4, Lots 2-A with Lots 3-A and 4-A

Since corn silage is relatively low in protein content, a ration in which this feed constitutes a large part of the roughage is likely to contain too small an amount of protein to produce the best results with breeding ewes, even though a part of the roughage consists of

clover or alfalfa hay. Experiments II and III furnish data to show the advisibility of supplementing silage with linseed meal. In these experiments Lot 2 was fed corn, corn silage and clover hay, while in Lots 3 and 4 the silage was supplemented with different amounts of linseed meal. In Experiments III, the two-year-old ewes in Lots 2-A, 3-A and 4-A were fed similarly to the older ewes in Lots 2, 3 and 4, respectively.

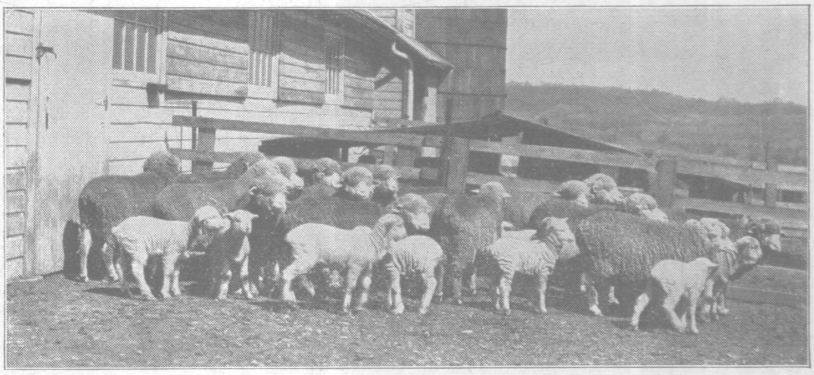

Fig. 7.—Lot 5 in Experiment V. Ewes fed corn, cottonseed meal, alfalfa (heavy) and silage

In this comparison all lots were fed approximately three-fourths of a pound of clover hay daily per head and as much corn silage as they would eat. Lots 3 and 3-A were fed approximately one pound of linseed meal for every 30 pounds of silage fed, while Lots 4 and 4-A were fed approximately one pound of linseed meal for every 10 pounds of silage fed. Table II shows that all the lots used in this comparison in Experiments II and III consumed practically the same average amount of total concentrates daily per head, but Lots 2 and 2-A consumed a smaller amount of silage and consequently a smaller amount of total feed daily per head than did Lots 3 and 4 and 3-A and 4-A, respectively. The addition of linseed meal to the ration not only induced a larger consumption of roughage but caused the ewes to consume a larger percent of the silage than did the ewes that were not fed linseed meal. Other experiments with breeding ewes as well as experiments with fattening lambs have shown that the addition of a concentrate relatively rich in protein induced a greater consumption of roughage.

Table III shows that the ewes in Lots 2 and 2-A made much smaller average daily gains than did those in Lots 3 and 4 and those in Lots 3-A and 4-A, respectively. Table VII indicates that

as a general thing the ewes in the lots fed linseed meal (Lots 3, 4, 3-A and 4-A) were in better condition at lambing time than were the ewes in the lots in which the silage was not supplemented with linseed meal (Lots 2 and 2-A).

Table IV shows no conclusive evidence to indicate that the lambs from the ewes fed linseed meal in connection with silage (Lots 3, 4, 3-A and 4-A) were heavier at birth than were the lambs from the ewes which were not fed linseed meal. The table shows, however, that with but one exception the lambs from the ewes fed linseed meal were heavier at ten days of age. The table also shows that in Experiment III the lambs from the ewes that were fed linseed meal in connection with silage were heavier at the close of the experiment and made decidedly greater average daily gains during the experiment. Table VII shows very conclusive evidence that supplementing the silage with linseed meal increased the milk flow of the ewes, which is reflected in the larger gains produced by the lambs. Table VI does not present any conclusive evidence that supplementing silage with linseed meal produced stronger or fatter lambs at birth than were produced by ewes which were not fed linseed meal. In this discussion of the weights and gains made by the lambs, only the single lambs have been considered.

Table VIII indicates that the addition of linseed meal to a ration composed of corn, corn silage and clover hay resulted in increases in the weight of fleece ranging from 1.3 percent to 6.4 percent.

Table IX shows that at the prices given for feeds the addition of linseed meal to a ration of corn, corn silage and clover hay increased the cost of the ration. With feeds at the prices given in the table the additional feed cost per ewe in each experiment was as follows:

Experiment	Days duration	Additional cost of feed per ewe for Lot 3 over Lot 2	Additional cost of feed per ewe for Lot 4 over Lon 2	Additional cost of feed per ewe for Lot 3—A over Lot 2—A	Additional cost of feed per ewe for Lot 4—A over Lot 2—A
II	124	$ .11	$ .29	$.	$
III	126	.11	.43	.18	.37

The foregoing tables and discussion indicate that the average value of the lambs from the ewes fed linseed meal was enough greater than that of the lambs from the ewes that were not fed linseed meal to more than offset the additional cost of the ration.

DIFFERENT AMOUNTS OF LINSEED MEAL AS A SUPPLEMENT TO CORN SILAGE

Compare Lot 3 with 4 and 3-A with 4-A

In the foregoing discussion it was demonstrated that the addition of linseed meal to a ration composed of corn, corn silage and clover hay for feeding ewes resulted in larger gains, heavier milk flow and slightly greater weight of fleece by the ewes and a more rapid growth on the part of the lambs. Since linseed meal is a feed which is relatively high in price it is of importance to know the minimum amount necessary to yield the best results. Lots 3 and 4 and 3-A and 4-A in Experiments I, II and III afford a comparison of two different amounts of linseed meal as a supplement to corn silage when fed in connection with corn and clover hay.

Fig. 8.—Lot 6 in Experiment V. Ewes fed corn, cottonseed meal, alfalfa (medium) and silage

Table II shows that in all three experiments Lot 3 was fed the same amount of hay as Lot 4, and Lot 3-A was fed the same amount as Lot 4-A. All lots were fed as much silage as they would consume. Lots 3 and 3-A were fed approximately one pound of linseed meal for every 30 pounds of silage fed, while Lots 4 and 4-A were fed approximately one pound of linseed meal for every 10 pounds of silage fed. In addition to the linseed meal enough corn was fed so that in all three experiments both lots in each pair were fed the same amount of total concentrates daily per head. Table II shows that in all three experiments Lots 4 and 4-A, fed the larger amount of linseed meal, consumed more silage and a larger amount of total roughage daily per head than did Lots 3 and 3-A, fed the smaller amount of linseed meal.

Table III shows no consistent or conclusive evidence that the ewes fed the larger amount of linseed meal (Lots 4 and 4-A) made

larger gains than those fed the smaller amount (Lots 3 and 3-A). Table VII indicates that with the exception of the two-year-old ewes (Lots 3-A and 4-A) in Experiment III, the ewes fed the larger amount of linseed meal were in better condition at lambing time than were those fed the smaller amount. Table VII also indicates that the ewes fed the larger amount of linseed meal produced a more generous flow of milk.

Fig. 9.—Lot 7 in Experiment V. Ewes fed corn, cottonseed meal, alfalfa (heavy) and silage

Table IV shows that in all three experiments the lambs from the old ewes fed the larger amount of linseed meal (Lot 4) were heavier at birth and at 10 days of age than were the lambs from the ewes fed the smaller amount (Lot 3). In Experiment III the lambs in Lot 4 were heavier at the close of the experiment and made a larger average daily gain than did those in Lot 3. In case of the two-year-old ewes, however, the evidence is not so definite and consistent. In Experiment I the lambs in Lot 3-A fed the smaller amount of linseed meal were heavier at birth than the lambs in Lot 4-A. In Experiment II the lambs in Lot 3-A were heavier at 10 days of age than were those in Lot 4-A. In Experiment III, the lambs in Lot 4-A were heavier at birth, at 10 days of age and at the close of the experiment, and made a larger average daily gain during the experiment than did the lambs in Lot 3-A. In this discussion only the single lambs have been considered.

Table VI shows evidence to indicate that the lambs from the old ewes fed the larger amount of linseed meal (Lot 4) were more vigorous and fatter at birth than those in Lot 3. With the exception of Experiment I, the same thing holds true for the lambs from the two-year-old ewes.

Table VIII shows no evidence to indicate that the difference in the amount of linseed meal fed to the ewes made any difference in the amount of wool produced.

Table IX shows that with feeds at the prices quoted, feeding the larger amount of linseed meal increased the cost of the average daily ration. On the basis of these prices the average increases in the cost of the ration per ewe for the entire period covered by each experiment were as follows:

Experiment	Days duration	Old ewes	Two-year-old ewes
I.....	94	$ .10	$ .09
II.....	124	.17	.21
III.....	126	.32	.19

It is impossible to measure the value of the additional vigor and the greater gains made by the lambs in Lots 4 and 4-A, whose dams were fed the larger amount of linseed meal. It would seem, however, that the lambs from these ewes received enough better start in life to more than pay for the additional cost of the ration.

CORN AND CLOVER VS. CORN, CLOVER, SILAGE AND OILMEAL

Compare Lot 1 with Lots 3 and 4

A very common ration for breeding ewes in the corn belt is one composed of corn and clover hay. Experiment III makes possible the comparison of such a ration (Lot 1) with rations in which a part of the clover hay was replaced by corn silage, supplemented with linseed meal (Lots 3 and 4).

The ewes in Lots 3 and 4 were fed approximately one-half a pound of total concentrates and approximately three-fourths of a pound of clover hay daily per head and what silage they would consume. The ewes in Lot 1 were fed approximately six-tenths of a pound of corn daily per head and as much clover hay as they would consume. Table II shows the average daily ration per head consumed by each lot.

Table III shows that the ewes in Lot 1, fed clover hay, made a larger average daily gain per head than those in either Lots 3 or 4, fed silage as a part of the roughage. Table VII indicates that the ewes in Lot 4 were in better condition at lambing time than those in Lot 1, while the ewes in Lot 1 were in better condition than those in Lot 3.

Table IV shows that the lambs in Lot 4 were larger at birth, at 10 days of age and at the close of the experiment and that they

made a decidedly greater average daily gain per head during the experiment than did the lambs in Lot 1. The lambs in Lot 3, however, were slightly smaller at birth and at 10 days of age and made only a slightly greater gain during the experiment than did the lambs in Lot 1. Table VI indicates that the lambs in Lots 3 and 4 were stronger at birth than were those in Lot 1.

Table VII does not indicate any striking difference in milk flow of the ewes fed clover hay alone as roughage and those fed clover hay and silage. What difference is indicated, however, seems to be in favor of the ewes fed silage in connection with clover hay, (Lots 3 and 4).

Table VIII shows no definite evidence that the addition of silage and linseed meal to a ration composed of corn and clover hay had any influence on the weight of fleece produced by the ewes.

Table IX shows that at the prices used the addition of silage, supplemented with linseed meal, to a ration composed of corn and clover hay reduced the cost of the ration.

The data presented seem to indicate rather conclusively that a ration of corn and clover hay may be improved from the standpoint of both efficiency and economy if corn silage is used to replace clover hay to the extent of approximately one-half the dry matter of the roughage, provided the silage is adequately supplemented with linseed meal or some other concentrate relatively rich in protein.

COMPARISON OF TWO-YEAR-OLD AND OLDER EWES

Compare Lots 2, 3 and 4 with Lots 2-A, 3-A and 4-A, respectively

Since the ewes in Lots 1 to 5, inclusive, contained ewes of varying ages, these experiments do not make possible a comparison of the efficiency of ewes of different ages, except a comparison of ewes raising their first lambs (Lots 2-A, 3-A and 4-A) with older ewes similarly fed (Lots 2, 3 and 4). Even this comparison is not strictly accurate, since each lot of older ewes contained a few crossbred ewes while the two-year-olds were all purebred or high grade Merinos.

Table II shows that in Experiments I and II the two-year-old ewes consumed enough less roughage that their total feed consumption was about 10 percent less than that for the older ewes. This difference in feed consumption corresponds rather closely to the difference in the average weight of the ewes. In Experiment III in which the two-year-old ewes weighed practically the same as the older ewes, the feed consumption was practically the same.

Table III shows that in Experiment I the older ewes made larger gains than did the two-year-old ewes similarly fed. In Experiments II and III the two-year-old ewes made larger gains than did the older ewes similarly fed. Table VII shows that with the exception of Experiment I, the two-year-old ewes were in better condition at lambing time than were the older ewes similarly fed. This table also indicates that the older ewes were better milkers than were the corresponding lots of two-year-old ewes. Table VIII shows that the two-year-old ewes were heavier shearers than the older ewes similarly fed. This difference is partly accounted for by the fact that each lot of old ewes contained a few crossbred ewes which were lighter shearers than the Merinos.

Fig. 10.—Lot 8 in Experiment V. Ewes fed corn, cottonseed meal, corn stover and silage

Table IV shows that in all three experiments the lambs from the older ewes were heavier at birth and at 10 days of age than were the lambs from the younger ewes fed the corresponding rations. In Experiment III the lambs from the older ewes were heavier at the close of the experiment but the lambs from the two-year-old ewes made the larger gains during the experiment. Table VI shows that the lambs from the older ewes were stronger and fatter at birth. There is no evidence in Table V to indicate that the ewes of either age raised a larger percent of the lambs born.

EXPERIMENT IV

OBJECT

The object of this experiment was to secure further data on the comparison, made in Lots 3 and 4, Experiments I, II and III, of large and small amounts of linseed meal as a supplement to corn silage for breeding ewes.

PLAN OF EXPERIMENT

Two lots of 21 ewes in each lot were used in this experiment which lasted from December 12, 1913 to March 16, 1914, inclusive, a period of 95 days. One ewe whose lamb died was removed from Lot 1 on January 31. Lot 1 was fed approximately 1 pound of linseed meal for every 30 pounds of silage, and Lot 2 was fed approximately 1 pound of linseed meal for 10 pounds of silage.

Sheep used.—With the exception of one purebred Merino ewe in each lot, the ewes used in the experiment were high grade Merinos of the light B and C types. The ewes ranged in age from 4 to 7 years, about two-thirds of them being four-year-olds. The ewes were bred to purebred Southdown rams, and lambed during January and the first 10 days of February.

Feeds used.—The same feeds used in Experiment I were used in Experiment IV. (See p. 131). The hay consisted of approximately 50 percent clover, 20 percent soybean hay and 30 percent alfalfa.

Method of feeding.—Lots 1 and 2 in this experiment were fed similarly to Lots 3 and 4, respectively, in Experiments I, II and III (see p. 132), except that the ewes in Experiment IV were fed heavier because they lambed much earlier in the experiment. Each lot was fed one-half of a pound of total concentrates, three-fourths of a pound of hay as much silage as they would consume. Table X shows the amounts and proportions of feeds consumed.

As soon as the lambs were old enough to eat they were fed hay and grain in racks and troughs behind lamb creeps. Both lots of lambs were fed the same feeds, in as nearly as possible the same amounts. The grain mixture was composed of a mixture of corn, oats, bran and linseed meal. Table XVI shows the amount of feed fed to the lambs.

Weights.—The statements regarding the method of weighing in Experiments I, II and III (see p. 132) will apply to Experiment IV.

Quarters.—Each lot was housed in one-half of a one-story shed 16 feet by 36 feet built on the west side of the main sheep barn.

Numerous windows in the south end and west side of the shed furnished abundant light and ventilation. Each lot was shifted weekly from one end of the shed to the other to overcome any difference which might exist between the two ends of the shed. Each lot of ewes and lambs also had access to an outside lot about twice the size of the shed space to which they were confined. The sheep were fed in racks described on p. 133.

Water, salt and bedding.—The sheep used in this experiment were supplied with water, salt and bedding in the same manner as those used in Experiments I, II and III. (See p. 133).

TABLE X.—EXPERIMENT IV. AVERAGE DAILY RATION CONSUMED, RATIO BETWEEN CONCENTRATES AND ROUGHAGE CONSUMED AND PERCENT OF ROUGHAGE EATEN

95 days, Dec. 12, 1913 to Mar. 16, 1914, inclusive.

Period		Lot 1	Lot 2
I 27 days	Total concentrates.....pounds..	.75	.76
	Silage.....pounds..	3.32	3.40
	Total roughage*.....pounds..	1.58	1.60
	Concentrates, 1; roughage*.....pounds..	2.10	2.10
II 28 days	Total concentrates.....pounds..	.75	.75
	Silage.....pounds..	3.07	3.48
	Total roughage*.....pounds..	1.50	1.64
	Concentrates, 1; roughage*.....pounds..	1.99	2.19
III 28 days	Total concentrates.....pounds..	.75	.75
	Silage.....pounds..	3.37	3.74
	Total roughage*.....pounds..	1.62	1.74
	Concentrates, 1; roughage*.....pounds..	2.16	2.32
IV 12 days	Total concentrates.....pounds..	.75	.75
	Silage.....pounds..	3.35	3.80
	Total roughage*.....pounds..	1.60	1.75
	Concentrates, 1; roughage*.....pounds..	2.13	2.34
Total 95 days	Corn.....pounds..	.63	.40
	Linseed meal.....pounds..	.12	.35
	Total concentrates.....pounds..	.75	.75
	Hay.....pounds..	.48	.48
	Silage.....pounds..	3.27	3.58
	Total roughage*.....pounds..	1.57	1.67
	Total feed.....pounds..	2.32	2.42
	Concentrates, 1; roughage*.....pounds..	2.09	2.22
	Percent hay consumed.....pounds..	96.20	96.34
	Percent silage consumed.....pounds..	96.21	98.78
	Silage fed per pound linseed meal consumed.....pounds..	28.30	10.38
	Silage consumed per pound linseed meal consumed..pounds..	27.23	10.25

*Hay plus one-third of silage fed. See p. 156 for explanation.

FEED CONSUMED

Table X shows the average amount of concentrates (aside from the grain contained in the silage), silage and total roughage consumed daily per head and the proportion of roughage and concentrates consumed for each four-week period. The table also shows, for the entire experiment, the average amount of each feed

consumed daily per head, the proportion of concentrates and roughage consumed, the percent of hay and silage consumed, and the number of pounds of silage fed and consumed for each pound of linseed meal consumed. As in the previous experiments reported the term "roughage" refers to the weight of the hay plus one-third of the weight of the silage, on the assumption that three pounds of silage contain approximately the same amount of dry matter as one pound of hay.

Table X shows that as in Experiments I, II and III, the ewes fed the larger amount of linseed meal (Lot 2) consumed a larger amount of silage, and since both lots were fed the same amount of concentrates and hay, Lot 2 consumed a larger proportion of roughage to concentrates than did Lot 1.

WEIGHTS AND GAINS

The ewes in Experiment IV were weighed in the same manner as the ewes in the experiments previously reported. (See p. 137). The lambs in Experiment III were weighed on three successive days at the close of the experiment.

TABLE XI.—EXPERIMENT IV. WEIGHTS AND GAINS—EWES
95 days, Dec. 12, 1913 to March 16, 1914, inclusive.

	Lot 1	Lot 2
	Pounds	*Pounds*
Initial weight, December 11, 12, 13, 1913	1840	1837
Final weight, March 16, 17, 18, 1914	1653	1775
Ewes removed	(1) 82	.....
Lambs born	207.5	196.25
Total gain	102.5	134.25
Average daily gain per head	.053	.067

Table XI shows the initial and final weight of the ewes, the weight of the lambs born during the experiment, the total gain per lot and the average daily gain per ewe. Table XI shows that as was generally the case in Experiments I, II and III, the ewes fed the larger amount of linseed meal (Lot 2) made the greater average daily gain.

Table XII shows the weight of the lambs at birth, at 10 days of age and at the close of the experiment, and also shows the average daily gain per head made by the lambs during the experiment. The lambs were not so weighed at the close of the experiment as to make it possible to determine the gains of the single and twin lambs separately. The table shows that the lambs from the ewes fed the larger amount of linseed meal (Lot 2) were heavier at birth, at 10 days and at the close of the experiment and that they made the larger average daily gain per head during the experiment.

After the close of the experiment both lots of ewes and lambs were fed alike until May 26. The ewes were allowed the run of a rye pasture until the lambs were weaned, on May 15. The lambs were confined to the barn and dry lot at all times. Table XII shows the weight of the lambs May 26 and the average daily gains produced from birth to that date. The weight of the lambs at birth is not included in the average daily gain. Table XII shows that the single lambs in Lot 2 whose dams were fed the larger amount of linseed meal made 13.8 percent greater gain than was made by the lambs in Lot 1. The difference in gain from March 16 to May 26 was due to the influence of the rations fed to the ewes prior to March 16. Had the experimental rations been continued until May 26, it is probable that the difference in favor of Lot 2 would have been even greater.

TABLE XII.—EXPERIMENT IV. WEIGHTS AND GAINS—LAMBS
95 days, Dec. 12, 1913 to March 16, 1914, inclusive.

	Lot 1		Lot 2	
	No.	Weight	No.	Weight
Average weight at birth: Singles.....pounds..	19	9.33	19	9.62
Twins.....pounds..	4	7.56	2	6.75
Average weight at 10 days of age: Singles.....pounds..	17	13.44	18	14.67
Twins.....pounds..	3	11.08	1	12.
Average weight at close of experiment.....pounds..	20†	26.9	20†	28.75
Average age at close of experiment: Singles.....pounds..	17	50.2	18	52.2
Twins.....pounds..	3	60.	2	50.
Average daily gain per head during experiment*...pounds..	20†	.344	20†	.369
Average weight May 26: Singles.....pounds..	17	47.76	18	53.39
Twins.....pounds..	3	53.67	2	42.25
Average daily gain to May 26: Singles.....pounds..	17	.311	18	.354
Twins.....pounds..	3	.335	2	.296

*Does not include birth weight of the lambs.
†Lambs were not weighed individually, which makes it impossible to give separate weights and gains for single and twin lambs.

WOOL PRODUCED

Table XIII shows the total and the average weight of wool per head produced by each lot. The table shows that the ewes in Lot 2, fed the larger amount of linseed meal produced about one-third of a pound more wool per head than did the ewes in Lot 1. Data from the experiments previously reported, Table III, p. 138, do not show that in all cases the larger amount of linseed meal produced heavier fleeces.

TABLE XIII.—EXPERIMENT IV. WOOL PRODUCED BY EWES

	Lot 1	Lot 2
	Pounds	*Pounds*
Total.....	165.3	172.7
Average per head..	7.87	8.23

CONDITION AND MILK FLOW OF EWES

Table XIV shows practically no difference between the two lots with respect to the condition of the ewes at lambing time. The table shows that the ewes in Lot 2, fed the larger amount of linseed meal, produced a decidedly more generous flow of milk than did the ewes in Lot 1. The difference in milk flow corresponds closely with the difference shown in Experiments I, II and III, Table VII, p. 143.

TABLE XIV.—EXPERIMENT IV. CONDITION AND MILK FLOW OF EWES

Lot	Condition			Milk flow			
	Thin	Average	Fat	Poor	Average	Good	Extra good
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
1	10	60	30	15	30	50	5
2	5	65	30	5	10	60	25

VIGOR AND CONDITION OF LAMBS

Table XV shows that as was true in the experiments previously reported in this bulletin (see Table VI, p. 142), the lambs from the ewes fed the larger amount of linseed meal (Lot 2) were stronger and fatter at birth than those from the ewes fed the smaller amount (Lot 1).

TABLE XV.—EXPERIMENT IV. VIGOR AND CONDITION OF LAMBS

Lot	Vigor			Condition		
	Weak	Average	Strong	Thin	Average	Fat
		Percent	*Percent*	*Percent*	*Percent*	*Percent*
1	.....	35.29	64.71	5.88	47.06	47.06
2	.....	11.11	88.89	.....	22.22	77.78

COST OF RATIONS

Table XVI shows the amount of the feed fed to the ewes and lambs and the average cost per head, at the prices used, for the rations fed to the ewes in each lot. The table shows that the additional daily cost of the ration containing the larger amount of linseed meal (Lot 2) was .18 of cent. This would make the additional cost of the ration for the entire experiment amount to but 17 cents per ewe. The data that have been presented in the foregoing tables indicate that the value of the lambs in Lot 2 exceeded those in Lot 1 by far more than this amount.

TABLE XVI.—EXPERIMENT IV. TOTAL FEED FED TO EWES AND LAMBS AND AVERAGE DAILY COST PER HEAD OF FEED FED TO EWES

	Lot 1				Lot 2			
	Ewes		Lambs		Ewes		Lambs	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Corn at 70 cents per bushel	1,211.1	$15.14	28.5	.36	805.1	$10.06	28.5	.36
Linseed meal at $36 per ton	230.1	4.14	9.5	.17	696.	12.53	9.5	.17
Hay at $10 per ton	960.	4.80	174.	.87	997.	4.98	169.	.84
Silage at $4 per ton	6,512.5	13.02			7 223.5	14.45		
Oats at 40 cents per bushel			48.	.60			.48	.60
Bran at $24 per ton			35.	.42			.35	.42
Total cost of feed	$37.10		$2.42		$42.02		$2.39	
"Sheep days" in experiment	1 919				1,995			
Average daily cost of feed per head, cents	1.93				2.11			

EXPERIMENTS V, VI AND VII

OBJECT

These experiments were planned to compare different combinations of corn, cottonseed meal, alfalfa and silage as winter rations for breeding ewes and to compare corn stover and alfalfa as supplemental dry roughages to feed with silage to breeding ewes. The principal comparisons made possible by these experiments are as follows:

Corn and alfalfa vs. corn, cottonseed meal, silage and alfalfa. Compare Lot 1 with Lots 3, 4, 5, 6 and 7.

Corn, cottonseed meal and silage vs. corn, cottonseed meal, alfalfa and silage. Compare Lot 2 with Lots 5, 6 and 7.

Different amounts of alfalfa in connection with corn, cottonseed meal and silage. Compare Lots 5, 6 and 7.

Adding alfalfa to a ration of corn, cottonseed meal and silage every day and only on alternate days. Compare Lot 3 with Lots 6 and 7.

Adding alfalfa to a ration of corn, cottonseed meal and silage every day and only during the latter half of the experiment. Compare Lot 4 with Lots 6 and 7.

Corn and alfalfa vs. corn, cottonseed meal and silage. Compare Lots 1 and 2.

Alfalfa hay and corn stover as supplemental dry roughages to feed in connection with silage. Compare Lot 8 with Lots 5, 6 and 7.

PLAN OF EXPERIMENTS

An outline of the three experiments is given in Table XVII, which shows the period covered by each experiment, the rations fed and the number of ewes in each lot. In each experiment a few ewes died or were removed from the experimental lots as is shown in Table XX. Lots 2 and 8 were omitted in Experiment VII.

Sheep used.—The ewes in the experiments were high-grade and purebred Merino ewes of the C and light B types, with the grade ewes largely predominating. The ewes which were regarded as grades contained little, if any, other than Merino blood, although they were not eligible to registry. The ewes varied somewhat in age and were bred differently in the different experiments. In Experiments V there were a few two-year-olds, about 55 percent were seven-year-olds and the remainder ranged between these age limits. Approximately one-half the ewes were bred to Merino rams, approximately one-fourth to Shropshire and one-fourth to Southdown rams. In Experiment VI about 25 percent of the ewes were 7 and 8 years of age, 25 percent were two-year-olds and the remainder ranged between these limits. About one-half the ewes

were bred to Southdown rams, about one-fourth to Shropshires and about one-fourth to Merinos. In Experiment VII there were one or two seven-year-old ewes in each lot, about one-fourth were two-year-olds, and the remainder varied from 3 to 6 years of age. Approximately one-half were bred to Merino rams, about one-fourth to Southdowns and one-fourth to Shropshires. All lots were made as nearly alike as possible with respect to age, weight and breeding of the ewes and the kind of rams to which they were bred.

TABLE XVII.—PLAN OF EXPERIMENTS

	Lot 1 Corn and alfalfa	Lot 2 Corn, cotton-seed meal and silage	Lot 3 Fed like Lots 2 and 6 on alternate days	Lot 4 First half like Lot 2; second half like Lot 6
Experiment V 126 days, December 13 (P. M.) 1916 to April 18, 1917 (A. M.) inclusive	21 ewes	20 ewes	20 ewes	.....
Experiment VI 126 days, December 18 (P. M.) 1917 to April 23, (A. M.) 1918, inclusive	23 ewes	23 ewes	23 ewes	.....
Experiment VII 126 days, December 10 (P. M.) 1919 to April 14, (A. M.) 1920, inclusive	22 ewes	.. ..	22 ewes	.. ..
	Lot 5 Corn, cotton-seed meal, alfalfa (heavy) and silage	Lot 6 Corn, cotton-seed meal, alfalfa (medium) and silage	Lot 7 Corn, cotton-seed meal, alfalfa (light) and silage	Lot 8 Corn, cotton-seed meal, corn stover and silage
Experiment V 126 days, December 13 (P. M.) 1916 to April 18 (A. M.) 1917, inclusive	20 ewes	21 ewes	20 ewes	20 ewes
Experiment VI 126 days, December 18 (P. M.) 1917 to April 23 (A. M.) 1918, inclusive	23 ewes	23 ewes	23 ewes	23 ewes
Experiment VII 126 days, December 10 (P. M.) 1919 to April 14 (A. M.) 1920, inclusive	22 ewes	22 ewes	22 ewes	.....

No ewes that were not reasonably certain to be with lamb were included in any of the experiments. Any ewes that were discovered not to be with lamb were removed from the experiments, as were ewes whose lambs died. Table XX shows the number of ewes that were removed from each lot in each experiment.

Feeds used.—The corn fed as grain and that used for silage was similar to that used in the preceding experiments and described on p. 131. The silage used in Experiment VII perhaps contained a larger proportion of grain than that used in the other two experiments. The alfalfa was shipped from central Ohio. It consisted of a mixture of first and second cuttings and was of good quality,

although that used in Experiment VII contained a small amount of bluegrass and timothy. The cottonseed meal contained 36 to 38 percent of crude protein. The corn stover used in Experiment V was of excellent quality, as there was but little rain in the fall and the stover was stored in the barn soon after husking. The stover used in Experiment VI was not of as good quality as that used in Experiment V. The stover was fed whole, in the racks described on p. 133.

TABLE XVIII.—PERCENTAGE COMPOSITION OF FEEDS, ASIDE FROM CORN, USED IN EXPERIMENT V

	Dry matter	Ash	Crude protein	Carbohydrates		
				Crude fiber	N—free extract	Ether extract
Cottonseed meal	90.81	6.32	35.88	13.16	29.30	6.15
Alfalfa hay (first cutting)	89.63	5.98	13.06	34.62	34.45	1.52
Alfalfa hay (second cutting)	88.25	6.27	14.06	28.78	37.26	1.88
Corn stover (edible report)*	86.79	7.14	5.96	27.15	45.19	1.36
Corn stover (inedible report)*	84.46	4.33	3.28	30.68	45.05	1.12
Corn silage	30.48	1.54	2.50	6.42	19.09	.93

*When the stover was sampled the parts that are usually eaten by sheep—the leaves, tassels and the finer parts of the husks were separated from the parts that are usually refused when whole stover is fed. In making this separation, two-fifths was selected as the edible part and three-fifths as the inedible part. Table XIX, p. 167, shows that a larger proportion of the stover was eaten than was assumed would be eaten when the sample was taken Therefore the analysis for the edible part as shown in this table would be slightly different than that of the part that was actually eaten.

Table XVIII shows the composition, as determined by the department of Dairy Husbandry of this Station, of the cottonseed meal, alfalfa hay, corn silage and corn stover used in Experiment V. The feeds used in Experiments VI and VII were not analysed.

Method of feeding.—The ewes were fed and the refused feed was collected and weighed as has been described for Experiments I, II and III, p. 132, except that in Lot 1 one-third of the hay was fed at noon and the other two-thirds in the morning and evening. All hay fed to the other lots was fed at noon. In Lot 2 the silage was fed morning, noon and evening. Lot 3 was fed like Lot 2 every other day and on alternating days was fed like Lot 6. During the first half of the experiments Lot 4 was fed like Lot 2 and during the latter half this lot was fed like Lot 6.

All lots were fed as nearly as possible the same nutritive ratio and the same proportion of concentrates and roughage for each four-week period. For the first four weeks the nutritive ratio was approximately 1 to 7; for the remainder of the experiments the ratio was approximately 1 to 6. The concentrates and roughage were so adjusted that the proportion of the two parts of the ration could be changed without changing the nutritive ratio of the ration.

At each four-week interval the proportion of concentrates to roughage was increased until the lambs had learned to eat grain; after that the proportion of concentrates was decreased (See Table XIX). At all times all lots were fed to the limits of their appetite, but all lots were required to consume as nearly as possible the same proportion of concentrates and roughage.

Fig. 11.—Lot 1 in Experiment VII. Ewes fed corn and alfalfa

As soon as they had learned to eat, at about two weeks of age, the lambs were fed grain and alfalfa in racks and troughs behind lamb creeps. At first the grain consisted of a mixture of cracked corn and bran, but was soon changed to whole corn. The lambs were fed as much hay and grain as they would consume, each lot being fed according to appetite. The lambs were fed and shut in the creeps before the ewes were fed and were kept confined until the ewes had eaten their grain and the greater part of their roughage.

Fig. 12.—Lot 3 in Experiment VII. Ewes fed corn, cottonseed meal and silage every other day and on alternating days corn, cottonseed meal, alfalfa and silage

Weights.—The initial and final weights of the ewes and the final weights of the lambs were secured by averaging three weights taken on successive days. Individual weights of the ewes and lambs were taken on one of the days on which the initial and final weights were taken. The ewes were weighed weekly during the experiment. All weights were taken soon after noon, after the ewes had been given their regular feed. On weigh days water was withheld from 9 A. M. until after the weights were taken. Ewes and lambs were weighed at lambing time and when the lambs were ten days old, as described on page 132.

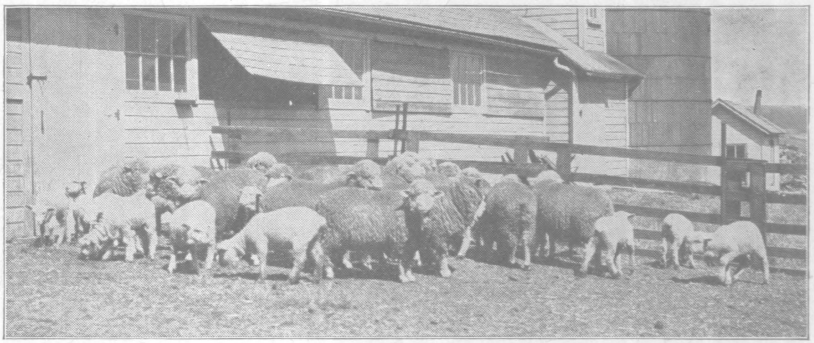

Fig. 13.—Lot 4 in Experiment VII. Ewes fed corn, cottonseed meal and silage during first half, and corn, cottonseed meal and alfalfa and silage during latter half of experiment

Quarters.—Lots 1 to 6, inclusive, in Experiments V and VI and all lots in Experiment VII were housed in a one-story feeding shed extending east and west and affording good light and ventilation. Each lot was confined to a pen 12 feet by 19 feet, including rack space, and an outside lot 12 feet by 36 feet on the south side of the shed. Lots 7 and 8 in Experiments V and VI were confined to pens and outside lots similar in size to those occupied by Lots 1 to 6, but were located in the shed used in Experiment IV and described on p. 156. The same feed racks were used that are described on p. 133.

Water, salt and bedding.—Water was kept before the ewes at all times, except shortly before weighing, in automatically regulated galvanized iron troughs. Common barrel salt was constantly before the ewes and lambs. The pens were kept well bedded with wheat straw.

TABLE XIX.—AVERAGE DAILY RATION CONSUMED, RATIO BETWEEN CONCENTRATES AND ROUGHAGE CONSUMED, AND PERCENT OF ROUGHAGES CONSUMED

Experiment V. December 13, 1916 to April 18, 1917.

Period		Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6	Lot 7	Lot 8
I 28 days	Total concentrates ..... pounds.	.40	.26	.28	.26	.36	.31	.32	.38
	Silage ..... pounds.	.....	4.58	4.19	4.59	3.13	3.70	4.21	4.12
	Total roughage‡ ..... pounds..	2.38	1.53	1.69	1.53	2.09	1.86	1.76	2.14
	Concentrates 1; roughage‡ ..... pounds..	5.93	5.98	5.99	5.97	5.88	5.94	5.59	5.65
II 28 days	Total concentrates ..... pounds..	.64	.39	.45	.39	.53	.46	.45	.55
	Silage ..... pounds..	.....	4.56	4.35	4.57	3.10	3.66	4.28	4.07
	Total roughage‡ ..... pounds..	2.51	1.52	1.78	1.52	2.06	1.83	1.79	2.09
	Concentrates, 1 roughage‡ ..... pounds..	3.90	3.92	3.95	3.93	3.93	3.97	3.97	3.81
III 14 days	Total concentrates ..... pounds.	.62	.36	.43	.40	.52	.43	.46	.50
	Silage ..... pounds..	.....	4.09	4.00	3.77	3.03	3.35	4.23	3.52
	Total roughage‡ ..... pounds.	2.43	1.36	1.64	1.55	2.02	1.65	1.77	1.83
	Concentrates, 1; roughage‡ ..... pounds.	3.92	3.75	3.86	3.86	3.90	3.84	3.90	3.65
IV 28 days	Total concentrates ..... pounds..	1.03	.59	.65	.75	.85	.68	.70	.84
	Silage ..... pounds..	.....	4.21	3.77	3.72	3.02	3.29	4.01	3.63
	Total roughage‡ ..... pounds..	2.45	1.40	1.55	1.85	2.03	1.65	1.68	1.91
	Concentrates, 1: roughage‡ ..... pounds..	2.38	2.37	2.42	2.48	2.38	2.42	2.42	2.28
V 28 days	Total concenrates ..... pounds.	1.09	.62	.68	.80	.95	.73	.73	.89
	Silage ..... pounds..	.....	4.36	3.88	3.78	3.36	3.48	3.48	4.02
	Total roughage‡ ..... pounds..	2.46	1.49	1.60	1.90	2.20	1.75	1.75	2.06
	Concentrates, 1; roughage‡ ..... pounds..	2.26	2.35	2.36	2.39	2.32	2.39	2.39	2.33
Total 126 days	Corn ..... pounds.	.77	.18	.27	.27	.50	.34	.28	.31
	Cottonseed meal ..... pounds.	.....	.26	.23	.25	.14	.19	.25	.33
	Total concentrates ..... pounds..	.77	.44	.50	.52	.64	.53	.53	.64
	Alfalfa ..... pounds..	2.45	.....	.63*	.63*	1.04	.59	.35	.....
	Stover ..... pounds..	.....	.....	.....	.....	.....	.....	.....	.72
	Silage ..... pounds..	.....	4.41	4.04	4.14	3.13	3.51	4.18	3.91
	Total roughage‡ ..... pounds..	2.45	1.47	1.65	1.67	2.08	1.76	1.75	2.03
	Total feed ..... pounds..	3.22	1.91	2.15	2.19	2.72	2.29	2.28	2.67
	Concentrates, 1: roughage‡ ..... pounds..	3.19	3.33	3.30	3.22	3.25	3.32	3.31	3.19
	Percent hay consumed	97.30	.....	100.00	99.72	97.07	99.51	100.0	53.40†
	Percent silage consumed	.....	96.89	98.17	97.70	97.68	98.27	98.27	92.54

*Average only for the days on which alfalfa was fed.
†Percent of stover consumed.
‡One-third of the weight of the silage regarded as roughage.

(See p. 133)

TABLE XIX.—AVERAGE DAILY RATION CONSUMED, RATIO BETWEEN CONCENTRATES AND ROUGHAGE CONSUMED, AND PERCENT OF ROUGHAGES CONSUMED—(Continued)

Experiment VI. December 18, 1917 to April 23, 1918.

Period		Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6	Lot 7	Lot 8
I 28 days	Total concentrates.....pounds	.43	.24	.27	.24	.34	.30	.27	.31
	Silage.....pounds	.....	4.33	3.89	4.35	3.02	3.67	3.83	3.62
	Total roughage‡.....pounds	2.57	1.44	1.62	1.45	2.06	1.84	1.60	1.83
	Concentrates, 1; roughage‡.....pounds	5.94	6.04	6.02	6.07	6.01	6.16	6.00	5.89
II 28 days	Total concentrates.....pounds	.65	.35	.40	.36	.52	.44	.40	.45
	Silage.....pounds	.....	4.17	3.86	4.25	3.10	3.49	3.89	3.51
	Total roughage‡.....pounds	2.59	1.39	1.61	1.42	2.06	1.75	1.62	1.78
	Concentrates, 1; roughage‡.....pounds	3.97	3.97	4.03	3.89	3.96	4.02	4.04	3.92
III 28 days	Total concentrates.....pounds	.92	.50	.53	.59	.67	.56	.56	.63
	Silage.....pounds	.....	4.46	3.91	3.84	2.97	3.36	3.98	3.58
	Total roughage‡.....pounds	2.73	1.49	1.59	1.74	1.97	1.68	1.66	1.82
	Concentrates, 1; roughage‡.....pounds	2.96	2.96	2.99	2.95	2.95	2.99	2.99	2.91
IV 28 days	Total concentrates.....pounds	1.40	.83	.80	.98	1.04	.87	.87	1.00
	Silage.....pounds	.....	4.80	3.88	3.90	3.10	3.46	3.46	3.75
	Total roughage‡.....pounds	2.72	1.60	1.59	1.95	2.07	1.74	1.74	1.95
	Concentrates, 1; roughage‡.....pounds	1.95	1.93	1.99	1.99	1.98	1.99	1.99	1.95
V 14 days	Total concentrates.....pounds	.95	.57	.54	.66	.66	.60	.56	.74
	Silage.....pounds	.....	4.84	3.91	3.93	3 12	3.55	4.03	4.24
	Total roughage‡.....pounds	2.79	1.61	1.60	1.96	2 07	1.77	1.68	2.16
	Concentrates, 1; roughage‡.....pounds	2.94	2.82	2.99	2.98	3.12	2.98	2.98	2.91
Total 126 days	Corn.....pounds	.84	.19	.28	.29	.51	.36	.29	.30
	Cottonseed meal.....pounds	.....	.26	.22	.25	.14	.19	.23	.29
	Total concentrates.....pounds	.84	.45	.50	.54	.65	.55	.52	.59
	Alfalfa.....pounds	2.66	.....	.60*	.65*	1.02	.59	.33	.....
	Stover.....pounds	.....	.....	.....	.....	.....	.....	.....	.65
	Silage.....pounds	.....	4.44	3.89	4.08	3.02	3.50	3.97	3.67
	Total roughage‡.....pounds	2.66	1.48	1.60	1.66	2.03	1.76	1.66	1.87
	Total feed.....pounds	3.50	1.93	2.10	2.20	2.68	2.31	2.18	2.46
	Concentrates, 1; roughage‡.....pounds	3.17	3.26	3.22	3.09	3.15	3.23	3.19	3.14
	Percent hay consumed.....pounds	98.19	.....	99.77	99.37	98.78	99.52	99.95	47.05†
	Percent silage consumed.....pounds	.....	97.74	99.39	99.01	98.05	98.89	99.15	95.69

*Average only for the days on which alfalfa was fed.
†Percent stover consumed.
‡One-third of the weight of the silage regarded as roughage. (See p. 133).

TABLE XIX.—AVERAGE DAILY RATION CONSUMED, RATIO BETWEEN CONCENTRATES AND ROUGHAGE CONSUMED, AND PERCENT OF ROUGHAGES CONSUMED—(Concluded)

Experiment VII. Dec. 10, 1919 to April 14, 1920.

Period		Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6	Lot 7	Lot 8
I 28 days	Total concentrates....pounds..	.40		.26	.24	.32	.31	.28	
	Silage....pounds..			3.86	4.37	2.98	3.66	4.03	
	Total roughage‡....pounds..	2.39		1.59	1.46	2.01	1.85	1.69	
	Concentrates, 1; roughage‡....pounds..	6.00		6.04	6.06	6.31	6.05	6.04	
II 28 days	Total concentrates....pounds..	.64		.42	.41	.55	.49	.44	
	Silage....pounds..			4.02	4.91	3.27	3.68	4.11	
	Total roughage‡....pounds..	2.51		1.65	1.64	2.15	1.84	1.72	
	Concentrates, 1; roughage‡....pounds..	5.92		3.98	3.97	3.90	3.76	3.95	
III 14 days	Total concentrates....pounds..	.85		.52	.57	.66	.59	.57	
	Silage....pounds..			3.76	3.38	2.96	3.52	3.97	
	Total roughage‡....pounds..	2.50		1.54	1.70	1.96	1.76	1.66	
	Concentrates, 1; roughage‡....pounds..	2.94		2.97	2.96	2.95	2.96	2.94	
IV 28 days	Total concentrates....pounds..	1.41		.85	1.00	1.18	.96	.83	
	Silage....pounds..			4.08	3.98	3.28	3.75	3.99	
	Total roughage‡....pounds..	2.75		1.67	1.98	2.12	1.86	1.65	
	Concentrates, 1; roughage‡....pounds..	1.95		1.97	1.98	1.79	1.93	2.00	
V 28 days	Total concentrates....pounds..	1.08		.64	.78	.86	.75	.86	
	Silage....pounds..			4.15	4.11	3.41	3.98	4.14	
	Total roughage‡....pounds..	2.86		1.68	2.07	2.28	2.00	1.73	
	Concentrates, 1; roughage‡....pounds..	2.64		2.64	2.67	2.66	2.67	2.02	
Total 126 days	Corn....pounds..	.86		.31	.33	.55	.40	.33	
	Cottonseed meal....pounds..			.23	.25	.15	.21	.25	
	Total concentrates....pounds..	.86		.54	.58	.70	.61	.58	
	Alfalfa....pounds..	2.61		.61*	.65*	1.05	.63	.34	
	Silage....pounds..			4.00	4.25	3.20	3.73	4.06	
	Total roughage‡....pounds..	2.61		1.64	1.76	2.12	1.87	1.70	
	Total feed....pounds..	3.47		2.18	2.34	2.82	2.48	2.28	
	Concentrates, 1; roughage‡....pounds..	3.04		3.04	3.02	3.05	3.05	2.93	
	Percent hay consumed....pounds..	98.13		99.44	99.77	97.83	99.08	99.45	
	Percent silage consumed....pounds..			98.84	99.27	99.33	99.22	98.76	

*Average only for the days on which silage was fed.

‡One-third of the weight of the silage regarded as roughage. (See p. 131).

FEED CONSUMED

Table XIX shows the average amount of concentrates (aside from grain contained in the silage), silage and total roughage consumed daily per head and the proportion of concentrates and roughage consumed during each four-week period. The table also shows the average amount of each feed consumed daily per head during each experiment, the proportion of concentrates and roughage consumed and the percent of hay and silage consumed.

WEIGHTS AND GAINS

Table XX shows the initial and final weights of the ewes and the average daily gain per head. The gain on the ewes was calculated as is explained on p. 132.

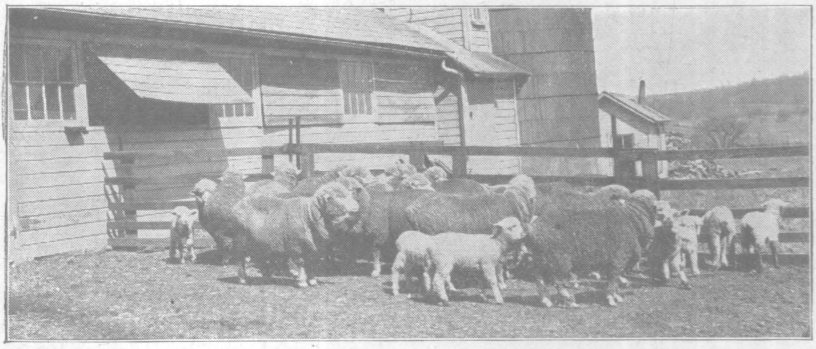

Fig. 14.—Lot 5 in Experiment VII. Ewes fed corn, cottonseed meal, alfalfa (heavy) and silage

Table XXI shows the average weight of lambs at birth, at ten days of age and at the close of the experiment, the age of the lambs at the close of the experiment and the average daily gain per head made by the lambs during the experiment. The weight of the lambs at birth is not included in the average daily gain per head. In the calculations in Table XXI a twin whose mate had died was still regarded as a twin. Lambs that were transferred from one lot to another because of the death of their mothers or because of inability of the ewes to raise them were not included in any of the computations in Table XXI after they were transferred. For this reason Table XXI does not show the total number of lambs raised in each lot. This information is given in Table XXII.

TABLE XX.—WEIGHTS AND GAINS—EWES

	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6	Lot 7	Lot 8
Experiment V, December 13, 1916 to April 18, 1917								
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Initial weight, December 12, 13, 14	1770	1723.5	1753.5	1696.5	1693.5	1786	1690	1710
Final weight, April 17, 18, 19	1525	1226.5	1346.5	1353.5	1321.5	1448.5	1458.5	1491.5
Ewes removed	(1) 65	(4) 285	(1) 101	(2) 144	(3) 22	(1) 50	(2) 130	(2) 142
Ewes died			(1) 60	(1) 75	(1) 96.5	(1) 78		
Lambs born	194.5	177.75	186.	178.	187.25	196.25	171.5	182.5
Wool shorn	175.5	123.6	147.3	125.7	134.70	147.3	138.8	133.7
Total gain	190.	89.35	87.3	179.7	266.45	134.05	208.8	239.7
Average daily gain per head	.073	.038	.035	075	.111	.052	.086	.099
Experiment VI, December 18, 1917 to April 23, 1918								
Initial weight, December 17, 18, 19	1965.	2026.5	2015.	2006.5	2011.5	1995	1996.5	2013.5
Final weight, April 22, 23, 24	1543.5	1055.	1500.	1426.5	1751.5	1548.5	1446.5	1451.5
Ewes removed	(4) 298	(8) 569	(2) 170	(4) 288		(2) 161	(3)213.5	(4) 301
Ewes died		(1) 64						
Lambs born	187.75	194.25	189.75	202.25	207.25	201.25	211.	213.5
Wool shorn	145.8	100.4	148.2	130.4	162.6	143.	135.6	131.
Total gain	210.05	—43.85	−7.05	40.65	109.85	58.75	10.1	83.5
Average daily gain per head	.081	— .018	— .003	.015	.038	.021	.004	.031
Experiment VII, December 10, 1919 to April 14, 1920								
Initial weight, December 9, 10, 11	2063.5		2068.5	2086.5	2053.5	2081.5	2055.	
Final weight, April 13, 14, 15	1580.		1806.5	1520.	1665.	1678.5	1483.5	
Ewes removed	(1) 112			(4) 382	(3) 278	(1) 85	(4) 38	
Ewes died	(1) 82					(1) 85		
Lambs born	181.25		213.	192.	177.75	188.	180.25	
Wool shorn	173.7		194.25	162.3	159.1	160.6	145.85	
Total gain	65.45		145.25	169.8	226.35	115.6	134.6	
Average daily gain per head	.025		.052	.066	.089	.043	.054	

TABLE XXI.—AVERAGE WEIGHTS AND GAINS—LAMBS

Experiment V. December 13, 1916 to April 18, 1917

	Lot 1		Lot 2		Lot 3		Lot 4		Lot 5		Lot 6		Lot 7		Lot 8	
	No.	*Lbs.*	*No.*	*Lbs.*	*No.*	*Lbs.*	*No.*	*Lbs.*	*No.*	*Lbs.*	*No.*	*Lbs.*	*No.*	*Lbs.*	*No.*	*Lbs.*
Weight at birth Singles	21	9.26	18	8.08	18	8.86	17	9.03	16	8.84	20	9.06	18	8.92	19	8.76
Twins			4	8.06	4	6.62	4	6.12	6	7.62	2	7.50	2	5.5	2	8.00
Weight at 10 days of age*. Singles	19	12.86	15	10.58	17	12.32	17	12.63	15	12.20	18	12.35	18	12.57	15	12.27
Twins			2	9.5	2	12.00	1	11.00	3	9.83	1	10.25	1	10.00	1	13.00
Weight at close of experiment*: Singles	19	29.34	14	21.36	16	27.44	17	28.91	13	27.58	17	26.65	16	28.41	15	25.43
Twins			2	23.25	2	32.00	1	27.50	3	28.00	1	25.00	1	18.00	1	33.5
Average age at close of experiment*. Singles	19	60.42	14	56.29	16	58.62	17	58.88	13	57.77	17	61.41	16	60.12	15	58.53
Twins																
Average daily gain at close of experiment.* Singles	19	.334	14	.231	16	.314	17	.338	13	.327	17	.283	16	.320	15	.279
Twins.																

Experiment VI. December 18, 1917 to April 23, 1918

Weight at birth: Singles	21	8.29	19	8.33	22	8.62	21	8.51	22	8.83	21	8.25	20	8.70	19	8.26
Twins	2	6.87	6	6.00			4	5.87	2	6.5	4	7.00	6	6.17	8	7.06
Weight at 10 days of age*: Singles	18	12.44	13	11.62	21	12.29	18	11.75	21	12.75	20	11.44	18	12.48	16	11.33
Twins	1	10.50	1	8.5			2	7.5	1	10.5	1	10.00	3	9.	5	9.35
Weight at close of experiment*: Singles	18	32.03	13	26.5	21	28.31	18	27.56	21	29.52	20	26.45	18	28.56	15	26.87
Twins	1	31 00	1	27.5			2	16.	1	21.5	1	17.5	2	23.25	5	25.20
Average age at close of experiment*: Singles	18	64.61	13	63.69	21	64.90	18	63.67	21	65.1	20	66.10	18	66.06	15	64.27
Twins																
Average daily gain at close of experiment:* Singles	18	.335	13	.275	21	.301	18	.294	21	.319	20	.273	18	.299	15	.283

*Does not include lambs transferred from one lot to another.

TABLE XXI.—AVERAGE WEIGHTS AND GAINS—LAMBS.—Concluded

Experiment VII. December 10, 1919 to April 14, 1920

	Lot 1		Lot 2		Lot 3		Lot 4		Lot 5		Lot 6		Lot 7		Lot 8	
	No.	*Lbs.*	*No.*	*Lbs.*	*No.*	*Lbs.*	*No.*	*Lbs.*	*No.*	*Lbs.*	*No.*	*Lbs.*	*No.*	*Lbs.*	*No.*	*Lbs.*
Weight at birth: Singles	22	8.24	.....	.....	18	9.93	17	8.91	17	8.84	18	8.87	16	9.14	.....	.....
Twins	.....	.....	.....	.....	8	6.53	6	6.75	4	6.87	4	7.06	6	5.67	.....	.....
Weight at 10 days of age*: Singles	20	12.9	.....	.....	18	12.47	15	12.42	15	13.12	17	13.19	16	13.19	.....	.....
Twins	.....	.....	.....	.....	4	9.62	4	8.56	3	10.92	2	10.25	3	8.75	.....	.....
Weight at close of experiment*: Singles	20	35.29	.....	.....	18	30.58	15	33.1	15	34.50	17	35.54	16	34.31	.....	.....
Twins	.....	.....	.....	.....	4	28.06	3	30.17	3	37.42	2	30.87	2	28.25	.....	.....
Average age at close of experiment*: Singles	20	65.25	.....	.....	18	63.78	15	66.	15	68.	17	67.41	16	64.81	.....	.....
Twins	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Average daily gain to close of experiment*: Singles	20	.411	.....	.....	18	.400	....	.367	.....	.376	.....	.394	.....	.388	.....	.....

*Does not include lambs transferred from one lot to another.

LAMBS RAISED

Occasionally, because of the death of a ewe or the inability of a ewe to suckle her lamb, a lamb was transferred from one lot to another where it was raised by another ewe. Table XXII shows the number of lambs born in each lot, the number of lambs that died and the number that were added to or removed from each lot, and the number of lambs remaining in each lot at the close of the experiment. The table also shows the number of ewes in each lot that did not have lambs.

TABLE XXII.—NUMBER OF LAMBS RAISED IN EACH LOT

	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6	Lot 7	Lot 8
Experiment V. 1916–1917								
Lambs born	21	22	22	21	22	22	20	21
Lambs died	1	5	3	3	5	2	2	5
Lambs removed	1	1	1	.....	1	2	1	.....
Lambs added to lot	1	.....	1	.....	.....	1	.....	2
Lambs in lot at close of experiment	20	16	19	18	16	19	17	18
Ewes not with lamb	.....	.....	.....	1	.....	.....	1	....
Experiment VI. 1917–1918								
Lambs born	23	25	22	25	24	25	26	27
Lambs died	4	11	1	5	2	4	5	7
Lambs removed	.....	.....	.....	.....	.....	.....	1	.....
Lambs added to lot	.....	.....	.....	.....	1	.....	.....	.....
Lambs in lot at close of experiment	19	14	21	20	23	21	20	20
Ewes not with lamb	1*	1	1	.....	.....	.....	.....	.....
Experiment VII. 1919–1920								
Lambs born	22	.....	26	23	21	22	22	.....
Lambs died	1	.....	2	5	3	1	4	.....
Lambs removed	1	.....	2	.....	.....	2	.....	.....
Lambs added to lot	.....	.....	.....	1	2	1	.....	.....
Lambs in lot at close of experiment	20	.....	22	19	20	20	18	.....
Ewes in with lamb	.....	.....	.....	1	2*	1*	3	.....

*Aborted.

WOOL PRODUCED

The ewes were shorn on the last two days of March each year, as explained on p. 137. Table XXIII shows the total and average weight of wool produced in each lot, for all the ewes remaining in the lot at the time they were shorn.

VIGOR AND CONDITION OF LAMBS

Table XXIV shows the vigor and condition of the lambs at birth. This table was compiled from records kept at lambing time as described on p. 142. Twin lambs were not included in the calculations shown in this table.

TABLE XXIII.—WOOL PRODUCED BY EWES*

	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6	Lot 7	Lot 8
			Experiment V. 1916-1917					
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Total	175.5	123.6	147.3	125.7	134.7	147.3	138.8	133.7
Average	8.8	7.3	7.4	7.0	7.5	7.4	7.3	7.4
			Experiment VI. 1917-1918					
Total	145.8	100.4	148.2	130.4	162.6	143.	135.6	131.
Average	7.7	7.2	7.1	6.9	7.1	6.8	6.8	6.9
			Experiment VII. 1919-1920					
Total	173.7	.....	194.25	162.3	159.1	160.6	145.85	.....
Average	8.7	.....	8.8	9.0	8.4	8.0	8.1	.....

*Includes only those ewes that remained in the experiment until shearing time.

TABLE XXIV.—VIGOR AND CONDITION OF LAMBS AT BIRTH

Lot No.	Vigor			Condition		
	Weak	Average	Strong	Thin	Average	Fat
			Experiment V. 1916-1917			
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
1	.....	19.05	80.95	4.76	42.86	52.38
2	5.55	27.78	66.67	5.55	72.22	22.22
3	5.55	16.67	77.78	5.55	44.44	50.00
4	.....	23.53	76.47	.....	70.59	29.41
5	.....	25.00	75.00	.....	43.75	56.25
6	.....	31.58	68.42	5.26	42.11	52.63
7	.....	16.67	83.33	5.56	22.22	72.22
8	.....	31.58	68.42	10.52	47.37	42.11
			Experiment VI. 1917-1918			
1	11.11	38.10	61.90	9.52	42.86	47.62
2	.....	22.22	66.67	11.11	50.00	38.89
3	.....	19.05	80.95	.....	28.57	71.43
4	.....	38.10	61.90	.....	47.62	42.38
5	.....	13.64	86.36	.....	27.27	72.73
6	4.76	14.29	80.95	4.76	42.86	52.38
7	5.00	20.00	75.00	5.00	45.00	50.00
8	.....	42.11	57.89	10.53	42.10	47.37
			Experiment VII. 1919-1920			
1	4.76	.....	95.24	4.76	61.91	33.33
2	.....	.....	.....	.....	.....	.....
3	.....	.....	100.00	.....	38.89	61.11
4	.....	5.88	94.12	5.88	47.06	47.06
5	.....	.....	100.00	.....	26.67	73.33
6	.....	.....	100.00	.....	38.89	61.11
7	.....	.....	100.00	.....	50.00	50.00
8	.....	.....	.....	.....	.....	.....

CONDITION AND MILK FLOW OF EWES

Table XXV shows a fairly accurate estimate of the milk flow of the ewes in the different lots. This table was compiled from notes taken during the suckling period, as described on p. 142.

TABLE XXV.—MILK FLOW OF EWES

Lot No.	Poor	Average	Good	Extra good
	Percent	*Percent*	*Percent*	*Percent*
Experiment V. 1916-1917				
1	4.76	33.33	52.38	9.53
2	40.00	15.00	40.00	5.00
3		35.00	60.00	5.00
4	15.79	21.05	63.16	
5	15.79	15.79	63.16	5.26
6	14.29	19.05	52.38	14.29
7	10.53	5.26	68.42	15.79
8	15.00	10.00	70.00	5.00
Experiment VI. 1917-1918				
1	18.18	13.64	50.00	18.18
2	42.86	19.05	33.33	4.76
3	9.52	23.81	57.15	9.52
4	34.78	21.74	30.44	13.04
5	4.35	4.35	73.91	17.39
6	21.74	21.74	39.13	17.39
7	4.35	4.35	78.26	13.04
8	39.13	8.70	47.82	4.35
Experiment VII. 1919-1920				
1	4.76	4.76	76.19	14.29
2				
3	13.63	18.18	54.55	13.63
4	9.52	42.86	33.33	14.29
5		10.53	57.89	31.58
6	4.76	23.81	42.86	28.57
7	10.00	25.00	35.00	30.00
8				

COST OF RATIONS

Table XXVI shows the amount of feed fed to the ewes in each lot and the average daily cost of the ration per ewe, with feeds charged at the prices used in the table.

Fig. 15.—Lot 6 in Experiment VII. Ewes fed corn, cottonseed meal, alfalfa (medium) and silage

TABLE XXVI.—TOTAL FEED FED TO EWES AND AVERAGE DAILY COST OF FEED PER HEAD

Experiment V

	Lot 1		Lot 2		Lot 3		Lot 4	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Corn at 70 cents per bushel	1994.75	$24.93	413.6	$5.17	673.5	$8.42	648.6	$8.11
Cottonseed meal at $30 per ton			617.6	9 26	576.	8.64	593.4	8.90
Alfalfa at $12 per ton	6544.	39.26			763.	4.58	707.0	4.24
Corn silage at $4 per ton			10626.	21.25	10271.	20.54	10124.	20.25
Total cost of feed		$64.19		35.68		42.18		41.50
"Sheep days" in experiment		2603.5		2337.5		2495.		2391.5
Average daily cost of feed per head, cents		2.47		1.53		1.69		1.74

	Lot 5		Lot 6		Lot 7		Lot 8	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Corn at 70 cents per bushel	1192.1	$14.90	879.	$10.99	679.3	$8.49	744.7	$9.31
Cottonseed meal $30 per ton	337.9	5.07	496.	7.44	606.6	9.10	794.8	11.92
Alfalfa at $12 per ton	2556.75	15.34	1534.	9.20	863.	5.18		
Corn stover at $4.50 per ton							3274.	7.37
Corn silage at $4.00 per ton	7670.	15.34	9260.	18.52	10350.	20.70	10242.	20.48
Total cost of feed		$50.65		$46.15		$43.47		$49.08
"Sheep days" in experiment		2390.		2593.		2435.5		2421.5
Average daily cost of feed per head, cents		2.12		1.78		1.78		2.03

TABLE XXVI.—TOTAL FEED FED TO EWES AND AVERAGE DAILY COST OF FEED PER HEAD—(Continued)

Experiment VI.

	Lot 1		Lot 2		Lot 3		Lot 4	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Corn at 70 cents per bushel	2179.75	$27.25	455.	$ 5.69	770.3	$ 9.63	770.5	$ 9.63
Cottonseed meal at $30 per ton			639.25	9.59	607.2	9.11	649.8	9.75
Alfalfa at $12 per ton	7040.	42.24			853.	5.12	787.5	4.72
Corn silage at $4 per ton			10958.	21.92	10829.	21.66	10930.	21.86
Total cost of feed	$69.49		$37 20		$45.52		$45.96	
"Sheep days" in experiment	2595.		2412.5		2767.		2650.	
Average daily cost of feed per head, cents	2.68		1.54		1.65		1.73	

	Lot 5		Lot 6		Lot 7		Lot 8	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Corn at 70 cents per bushel	1463.4	$18.29	1011.5	$12.64	783.1	$ 9.79	821.2	$10.26
Cottonseed meal at $30 per ton	408.3	6.12	524.5	7.87	641.1	9.62	785.1	11.78
Alfalfa at $12 per ton	3006.	18.04	1670.5	10.02	916.5	5.50		
Corn stover at $4.50 per ton							3707.	8.34
Corn silage at $4 per ton	8940.	17.88	10015.	20.03	10987.	21.97	10352.	20.70
Total cost of feed	$60.33		$50.56		$46.88		51.08	
"Sheep days" in experiment	2898.		2829.		2746.5		2697.	
Average daily cost of feed per head, cents	2.08		1.79		1.71		1.89	

TABLE XXVI.—TOTAL FEED FED TO EWES AND AVERAGE DAILY COST OF FEED PER HEAD—(Continued)

Experiment VII.

	Lot 1		Lot 3		Lot 4		Lot 5	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Corn at 70 cents per bushel	2297.8	$28.72	849.5	$10.62	846.6	$10.58	1406.3	$17.58
Cottonseed meal at $30 per ton	.....	.....	640.5	9.61	650.6	9.76	382.8	5.74
Alfalfa at $12 per ton	6934.	41.60	841.25	5.05	878.	5.27	2678.5	16.07
Corn silage at $4 per ton	.....	.....	11086.	22.17	10943.	21.89	8149.	16.30
Total cost of feed	$70.32		$47.45		$47.50		$55.69	
"Sheep days" in experiment	2660.5		2772.		2575.		2548.5	
Average daily cost of feed per head, cents	2.64		1.71		1.84		2.19	

	Lot 6		Lot 7	
	Pounds	Value	Pounds	Value
Corn at 70 cents per bushel	1076.2	$13.45	829.1	$10.36
Cottonseed meal at $30 per ton	556.6	8.35	615.2	9.23
Alfalfa at $12 per ton	1666.0	10.00	858.	5.15
Corn silage at $4 per ton	9924.	19.85	10139.	20.28
Total cost of feed	$51.66		$45.02	
"Sheep days" in experiment	2657.5		2499.5	
Average daily cost of feed per head, cents	1.94		1.80	

CORN AND ALFALFA VS. CORN, COTTONSEED MEAL, SILAGE AND ALFALFA

Compare Lot 1 with Lots 3, 4, 5, 6 and 7

This topic covers questions which perhaps concern more sheepmen than do any other questions regarding the feeding of breeding ewes. The best feeders have long recognized the superiority of a ration composed of corn or oats, or a mixture of the two grains, and a leguminous roughage such as clover or alfalfa hay, but with the growing popularity and the constantly increasing number of silos they are confronted with questions concerning the possibilities of silage as a feed for sheep. Is silage a safe feed for sheep? If so, in what quantities should it be fed and with what other feeds should it be combined? What effect will the addition of silage to a ration composed of corn and clover or alfalfa hay have upon the efficiency and economy of the ration? These questions confront both the small flock owner who has a silo for other classes of livestock and is hesitating about feeding it to sheep, and the large operator who is contemplating the purchase of a silo wholly or largely to supply feed for his flock. The experiments herein reported were planned with the hope of throwing light on some of these questions.

Fig. 16.—Lot 7 in Experiment VII. Ewes fed corn, cottonseed meal, alfalfa (light) and silage

Experiments V, VI and VII show comparisons of a ration of corn and alfalfa hay (Lot 1) with rations in which the hay was replaced, in varying degrees, with corn silage and in which the silage was fed in different ways (Lots 3 to 7 inclusive). In the rations in which alfalfa hay constituted the sole roughage no protein supplement was fed, as corn and alfalfa hay have proved to be an efficient ration. Wherever silage was added to a ration it was

supplemented with a sufficient amount of cottonseed meal to make the nutritive ratio of the ration approximately equal to that of the ration composed of corn and alafalfa. (See p. 131). In these comparisons alfalfa rather than clover hay was used because of the greater ease of securing a supply of a more nearly uniform quality from year to year. Other experiments conducted by this Station (Bulletin 245) indicate that the data thus secured from feeding alfalfa can be applied pretty closely to clover hay.

Table XIX shows that in all three experiments the ewes fed alfalfa as roughage (Lot 1) consumed more concentrates per head than did the ewes in the lots in which silage was fed along with the alfalfa. However, if the grain in the silage is taken into account (conservatively estimated at one-eighth of the weight of the silage) the lots fed silage consumed a larger average daily amount of concentrates than did Lot 1. The ewes in Lot 1 consumed a larger amount of roughage and of total feed than did those in the lots fed silage.

Table XX makes possible no definite conclusion regarding the effects of feeding silage upon the amount of gain produced by the ewes. In Experiment VI the ewes fed alfalfa as roughage (Lot 1) made a larger average daily gain than any of the other lots. In Experiment V the ewes in a number of lots fed silage made larger gains than those in Lot 1, fed alfalfa. In Experiment VII the ewes in Lot 1 made the smallest gains of any of the lots. A possible explanation of this is that the silage fed in this experiment contained a larger proportion of grain than that used in the other experiments and the alfalfa was not quite so good, owing to the presence of a small amount of bluegrass and timothy. As has already been stated, the gain produced by the ewes cannot be accurately determined and is not an important measure of the efficiency of rations for breeding ewes.

The data presented in Table XXV indicate that the ewes fed silage in addition to the alfalfa (Lot 3 to 7, inclusive) produced fully as generous a milk flow as did the ewes fed alfalfa as the sole roughage (Lot 1).

There is no evidence from these experiments to indicate that silage was injurious to the health of the ewes when it was supplemented with some form of dry roughage, even when it constituted as large a part of the roughage as it did in Lot 7. Table XX shows that in Experiment V, one ewe died in each of the following Lots, 3, 4, 5 and 6, and in Experiment VII one ewe died in Lot 1

and one in Lot 6. The death of only one of these ewes was suspected to be due to the feeding of silage and even in this case there was no definite evidence to indicate that this was the cause of death. The death of the other ewes could in no wise be attributed to the silage.

This Station has lost a few sheep from forage poisoning supposedly due to feeding silage but it was not at all certain that this was the cause. Losses have occurred from this disease in lots in which no silage was fed, but it seems that forage poison occurs more frequently when silage is fed.

It is important that silage intended for sheep should be made from corn that is pretty well matured, as sheep are less able than cattle to tolerate silage that is high in acidity. It is also necessary to avoid feeding mouldy silage to sheep. Apparently not all moulds are injurious but it is a safe precaution to avoid all silage that is seriously mouldy.

Table XXIV shows no indication whatever that replacing even a large part of the alfalfa hay with corn silage impaired the vigor or the condition of the lambs at birth. On the contrary, this table clearly indicates that in both these respects in Experiment VII the lambs from the ewes fed silage in addition to alfalfa surpassed the lambs from the ewes fed alfalfa as the sole roughage. This is probably due to the larger proportion of grain contained in the silage used in Experiment VII. Table XXII indicates, however, that in nearly all cases a larger proportion of the lambs born was raised in Lot 1 in which the ewes were fed alfalfa as the sole roughage.

Table XXI shows no consistent difference in the birth weight of the lambs from the ewes fed alfalfa as roughage and from the ewes fed silage and alfalfa. In Experiment V the lambs in Lot 1 were heavier and in Experiment VII they were lighter than those in any of the lots fed silage in addition to the alfalfa. In Experiment VI the lambs in Lot 1 were also the lightest at birth, with a single exception. In Experiment V the lambs from the ewes fed alfalfa as roughage were heavier at ten days of age than were those in any of the other lots. In Experiments VI and VII, however, the lambs in a number of the lots fed silage were heavier at ten days of age than were the lambs in Lot 1. With but one exception the lambs in Lot 1, fed alfalfa as the sole roughage, made a larger average daily gain per head during the experiment than did those in any of the lots fed silage and alfalfa. Only single lambs have been considered in this discussion.

Table XXVI shows that the substitution of silage for a part of the alfalfa in a ration of corn and alfalfa effected a material saving in the cost of the ration.

CORN, COTTONSEED MEAL AND SILAGE VS. CORN, COTTONSEED MEAL, ALFALFA AND SILAGE

Compare Lot 2 with Lots 5, 6 and 7

In the immediately preceding pages it has been shown that a ration of corn and alfalfa for breeding ewes can be cheapened without lowering its efficiency by substituting corn silage, properly supplemented with cottonseed meal, for a considerable part of the alfalfa. This brings up a question as to the results of replacing all the alfalfa with corn silage. Experiments I, II and III, pp. 130 to 155, furnish some data regarding the desirability of feeding silage as the sole roughage to breeding ewes, and Experiments V, VI and VII throw further light on this question.

Lot 2 was fed a ration of corn, corn silage and cottonseed meal, while Lots 5, 6 and 7 were fed rations containing varying amounts of alfalfa hay in addition to the feeds fed to Lot 2. All rations had as nearly as possible the same nutritive ratio and the same proportion of concentrates and roughage. (See p. 135).

Table XIX shows that Lot 2 consumed a smaller amount of concentrates daily per head than did Lots 5, 6 and 7, but if the grain contained in the silage is considered, all four lots consumed approximately the same amount of concentrates. Lot 2, fed silage as the sole roughage, consumed more silage but less total roughage and less total feed than was consumed by Lots 5, 6 and 7, fed silage and alfalfa. The amount of silage consumed in the different lots is of interest. In Lot 2, where silage was fed as the sole roughage, ewes weighing around 90 pounds consumed an average of almost 4.5 pounds for the entire feeding period of 18 weeks. In Lots 5, 6 and 7, fed alfalfa with the silage, the average amount of silage consumed daily per head ranged from three to four pounds, depending upon the amount of alfalfa fed.

Table XX shows that in Experiment V the ewes in the three lots fed silage and alfalfa made larger average daily gains per head than did those fed silage alone as roughage. In Experiment VI all three lots fed silage and alfalfa made slight gains in weight, while those fed silage as the sole roughage lost in weight.

Table XXV shows that the ewes in Lot 2 were decidedly poorer milkers than those in Lots 5, 6 and 7.

Table XXIV shows that the lambs from ewes fed silage as the sole roughage (Lot 2) were in decidedly thinner flesh at birth and less vigorous than lambs from ewes fed silage and alfalfa. (Lots 5, 6 and 7). Table XXII shows that a much smaller percent of the lambs born was raised in Lot 2 than was raised in the other lots. The lambs in Lot 2 were weak and the ewes failed to furnish enough milk to keep the lambs alive for more than a few days. In Experiment VI only 56 percent of the lambs born were living at the close of the experiment. Table XXI shows that with the exception of Lot 6 in Experiment VI the lambs from the ewes fed silage and alfalfa were heavier at birth and at ten days of age and made larger average daily gains per head than did the lambs from the ewes fed silage as the sole roughage (Lot 2). Only single lambs were included in this discussion.

Table XXVI shows that at the prices used for feeds the ration composed of corn, cottonseed meal and silage was cheaper than those including alfalfa in addition to these feeds. The effects of such a ration, however, on both ewes and lambs were such as to make it unsatisfactory, notwithstanding the low cost. The results secured from a ration of corn, cottonseed meal and silage were so unsatisfactory in Experiments V and VI that it was not thought desirable to include such a ration in Experiment VII.

COMPARISON OF VARYING AMOUNTS OF ALFALFA IN CONNECTION WITH CORN, COTTONSEED MEAL AND SILAGE

Compare Lots 5, 6 and 7

In the two preceding discussions it has been shown that a ration composed of corn and alfalfa can be cheapened without lowering the efficiency of the ration, by replacing a part of the alfalfa with corn silage, properly supplemented with cottonseed meal, but that the alfalfa cannot be wholly replaced by silage if the best results are to be secured. Experiments V, VI and VII were planned so as to yield some data to indicate the extent to which alfalfa may be replaced with corn silage. Since it frequently happens that clover or alfalfa hay are scarce or their price does not seem to justify a liberal use in the ration for breeding ewes, it is desirable to know the minimum amount of such hay that can be fed if good results are to be secured.

Lots 5, 6 and 7 were fed silage and alfalfa in varying proportions, so adjusted that in Lot 5 the dry matter in the roughage was furnished in equal amounts by alfalfa and silage, in Lot 6 alfalfa furnished one-third and silage two-thirds of the dry matter

in the roughage, and in Lot 7 alfalfa furnished one-fourth and silage three-fourths of the dry matter in the roughage. In making the rations conform to these proportions it was assumed that three pounds of silage furnished as much dry matter as one pound of alfalfa. On a fresh basis Lots 5, 6 and 7 were fed three, six and twelve times, respectively, as many pounds of silage as of alfalfa. The silage was so supplemented with cottonseed meal that all three rations had approximately the same nutritive ratio. All three lots were fed as nearly as possible the same proportion of concentrates and roughage. (See p. 164).

Table XIX shows that Lots 5, 6 and 7 consumed alfalfa and silage in about the desired proportions and that they consumed about the same proportions of concentrates and roughage. As the proportion of alfalfa in the ration decreased, however, the consumption of total feed also decreased.

Table XX shows such wide differences in the average daily gains produced by the ewes as to indicate that the proportion of silage and alfalfa in the ration exerted no consistent influence on such gains.

Table XXV shows that only in Experiment VII was there any definite indication that the milk flow of the ewes was affected by the proportion of silage and alfalfa fed. In this experiment the larger the proportion of alfalfa, the more generous was the milk flow of the ewes.

Table XXIV indicates that in Experiment V the vigor of the lambs at birth increased as the proportion of alfalfa in the ration was increased, while in Experiment VI the opposite tendency prevailed. In Experiment VII there was no difference noted between the lots in this respect. Table XXIV shows that with one exception increases in the proportion of alfalfa in the ration resulted in higher condition of the lambs at birth. Table XXII shows that, as a rule, an increase in the proportion of alfalfa in the ration resulted in the raising of a larger percent of the lambs born. Table XXI shows that in Experiment VII the birth weight of the lambs increased with each increase in the proportion of silage in the ration. In the other experiments there seems to be no correlation between the proportion of the two roughages fed and the birth weight of the lambs. In Experiments V and VII there was a slight increase in the weight of the lambs at ten days of age with increased proportions of silage in the rations, but these increases were so slight, and were not apparent at all in Experiment VI, that but little importance can be attached to them. Table XXI presents

no evidence to indicate any consistent influence of the proportions of silage and alfalfa fed upon the rate of gain produced by the lambs during the experiment.

Table XXVI shows that at the prices used for feeds the average daily cost of the ration increased with the increase in proportion of alfalfa in the ration. The results from the rations, as previously discussed, do not indicate any decided advantage from feeding the larger amounts of alfalfa. These comparisons seem to indicate quite clearly that satisfactory results may be secured from rations composed of corn, cottonseed meal, alfalfa (or clover) and corn silage, even when alfalfa constitutes as small a proportion of the ration as it did in Lot 7, where only approximately one-third of a pound was fed daily per head. In combining these roughages the intelligent feeder will govern the proportion by the amount of each available and their relative prices.

METHODS OF FEEDING ALFALFA WHEN THE AVAILABLE AMOUNT IS LIMITED

Compare Lots 3, 4 and 7

It was shown in the preceding discussion that when the amount of clover or alfalfa hay is limited or the price does not seem to justify an extensive use of such roughages for feeding breeding ewes, a ration of corn, cottonseed meal and silage and one-third of a pound of alfalfa daily per ewe gave excellent results. When corn silage is depended upon as the main source of roughage and the amount of legume hay is seriously limited, the feeder is concerned with how to combine this limited amount of hay with the silage to produce the best results. Under such circumstances the feeder is confronted with three possibilities, viz., (1) feeding a small amount of hay every day, (2) feeding a larger amount of hay every other day and on alternate days feeding silage alone as roughage, and (3) feeding silage as the sole roughage during the first half of the feeding period and saving the hay so it can be fed in larger amounts during the latter half of the period as lambing time approaches, and while the ewes are suckling the lambs.

Lots 3, 4 and 7 show a comparison of these three methods of feeding alfalfa in limited amounts along with corn silage. Lot 7 was fed a small amount, about one-third of a pound daily per head, throughout the experiment. Lot 3 was fed an average of approximately .6 of a pound of alfalfa every other day throughout the experiment and on alternate days was fed silage as the sole roughage. During the first half of the experiments Lot 4 was fed like Lot 2 on a ration of corn, cottonseed meal and silage, and during the latter

half was fed alfalfa in addition to silage, making a ration very similar to that fed Lot 6 and that fed Lot 3 on days when silage was fed to this lot.

The average amount of feeds consumed daily per head by each lot for each four-week period and for the entire experiment is shown in Table XIX. This table might leave the wrong impression that Lots 3 and 4 consumed more alfalfa than did Lot 7. This table shows the average daily amount of alfalfa consumed only for the days on which alfalfa was fed, which in the case of Lots 3 and 4 was only on one-half of the days of the experiment, so that the average daily amount consumed per head by these lots for the entire experiment was slightly less than that consumed by Lot 7. Table XIX also shows that the average daily amount of the other feeds consumed per head was practically the same in all three lots. The rations fed the three lots also had as nearly as possible the same nutritive ratio and the same proportion of concentrates to roughage.

Table XX shows no consistent difference in the gains produced by the ewes fed the three rations under discussion. Table XXV indicates that with respect to the milk flow produced by the ewes, Lots 3 and 7 were better than Lot 4, and Lot 7 was better than Lot 3.

Table XXIV indicates that the lambs in Lot 4 were less vigorous than those in Lots 3 and 7. There was no important difference between Lots 3 and 7 in this respect. Table XXIV shows that the lambs in Lots 3 and 7 were slightly fatter at birth than those in Lot 4.

Table XXII shows that a larger percent of the lambs born was raised in Lots 3 and 7 than was raised in Lot 4.

Table XXI shows no consistent difference in the birth weight of the lambs in the three lots. The table shows, however, that when ten days of age the lambs in Lot 7 were heavier than those in Lots 3 and 4. There was no important or consistent difference between Lots 3 and 4 with respect to the weight of the lambs at 10 days of age or the average daily gains produced during the experiment. In Experiments VI and VII the average daily gains produced by the lambs in Lot 3 were the highest and in Experiment V they were the lowest of the three lots. In Experiment V the gains produced by Lot 4 were the highest and in the other two experiments they were the lowest of the three lots.

Table XXVI shows that the average daily cost of the ration per ewe was greater for Lot 4 than for Lots 3 and 7. This, together

with the poorer results produced in this lot, indicates that the method of feeding followed in Lot 4 has little to commend it if it is possible to feed a small amount of alfalfa daily or on alternate days throughout the experiment. Table XXVI also shows that the average daily cost of the ration fed to Lot 3 was somewhat less than that fed to Lot 7, but it is doubtful if this difference was enough to offset the slightly better results produced by Lot 7.

ALFALFA HAY AND CORN STOVER AS SUPPLEMENTAL DRY ROUGHAGES TO FEED IN CONNECTION WITH SILAGE

Compare Lot 8 with Lots 5, 6 and 7

On corn belt farms it is frequently desirable to utilize non-leguminous roughages, such as corn stover and oat straw for feeding sheep. Because of their lack of succulence and their relatively low protein content and low palatability such feeds, when fed as the sole roughage to breeding ewes, frequently do not produce the most desirable results. A problem, then, which frequently confronts corn belt farmers, is how to combine these roughages with other feeds so that they may be efficiently utilized. What would seem to be the best method of utilizing such roughages would be to combine them with silage to make up for their lack of succulency and to supplement them with cottonseed or linseed meal to make good their deficiency in protein.

In the foregoing discussion it has been shown that corn silage is not a desirable feed for breeding ewes when fed as the sole roughage, but that excellent results were secured when the silage was supplemented with even a relatively small amount of alfalfa hay. The frequent high price of alfalfa or clover raises the question as to whether some cheaper roughage may not be used to supplement silage. Experiments V and VI make possible a comparison of corn stover and alfalfa hay as supplemental dry roughages to feed in connection with corn silage.

In Lot 8 the silage was supplemented with corn stover, while in Lots 5, 6 and 7 the silage was supplemented with varying amounts of alfalfa. The silage and stover were supplemented with cottonseed meal so that all lots had as nearly as possible the same nutritive ratio and carried practically the same proportion of concentrates and roughage. Table XIX shows the average daily amount of each feed consumed per ewe for each lot.

Table XX shows that so far as the gains produced by the ewes are concerned, corn stover compared very favorably with alfalfa as a roughage to feed in connection with silage, particularly in Lots 6

and 7 in which the amount of alfalfa consumed did not exceed the amount of stover consumed in Lot 8. Table XXV does not show any striking difference in milk flow in Lots 5, 6, 7 and 8 in Experiment V, but in Experiment VI the ewes in Lots 5, 6 and 7, fed alfalfa, produced a more generous flow of milk than did those in Lot 8 fed corn stover.

Table XXIV shows that the lambs from the ewes fed corn stover, Lot 8, were in a poorer condition at birth than those from the ewes fed silage, Lots 5, 6 and 7. This table also shows that the lambs in Lot 8 were generally less vigorous than those in Lots 5, 6 and 7, particularly in Experiment VI where the stover fed was of poorer quality than that fed in Experiment V. Table XXII shows that the percent of lambs raised was somewhat lower for Lot 8 than for Lots 5, 6 and 7.

Table XXI shows that with one exception the lambs in Lot 8 were lighter at birth and at ten days of age and made a smaller average daily gain per head during the experiment than the lambs in Lots 5, 6 and 7.

Table XXVI shows that, at the prices used for feeds, the average daily cost of the ration per ewe was not lowered by substituting corn stover for alfalfa as a supplemental roughage to silage, except in Lot 5 where the alfalfa constituted a large proportion of the roughage fed. Had the stover constituted as large a proportion of the roughage in Lot 8 as did the alfalfa in Lot 5, it is quite probable that the cost of the ration for Lot 8 would have exceeded that for Lot 5. The explanation for the higher cost of the ration in Lot 8 is that the cost of the additional amount of cottonseed meal required to supplement the stover more than offset any saving in the cost of the roughage. It is entirely possible, however, to have prices for feeds such as to make the ration fed to Lot 8 cheaper than that fed to Lots 6 and 7.

Experiments V and VI show that when no leguminous roughage is available a fairly satisfactory ration may be composed of corn, corn silage and corn stover, provided these feeds are adequately supplemented with a protein supplement such as cottonseed or linseed meal. Such a ration gave decidedly better results than did a similar ration from which the stover was omitted and silage fed as the sole roughage. The experiments indicate, however, that better results were secured when the silage was supplemented with alfalfa in an amount as small as one-third of a pound daily per head. This does not mean that such roughages as corn stover and oat straw cannot be economically utilized in the ration

for breeding ewes. Possibly the best method of utilizing such roughages would be to feed them, preferably in connection with silage, in the earlier part of the winter before they have deteriorated in palatability and feeding value, as is frequently the case with corn stover, and when the ewes can utilize them to better advantage than when they are suckling their lambs. If such roughages are to be fed throughout the winter and spring feeding period the ration can be improved by allowing clover or alfalfa to constitute one-half of the dry roughage fed, especially after the ewes have lambed.

CORN AND ALFALFA VS. CORN, COTTONSEED MEAL AND SILAGE

Compare Lots 1 and 2

These two rations represent perhaps the widest contrast with respect to roughage of any rations that are likely to be fed to breeding ewes on corn belt farms, and the flock owner is seldom confronted with necessity of choosing between such rations. The data yielded by these experiments make the matter of such a choice a simple one unless most unusual prices for feeds prevail. Table XXVI shows that the average daily cost of a ration composed of corn, cottonseed meal and silage was much lower than that of a ration composed of corn and alfalfa, but the less abundant milk flow of the ewes, the lower vitality of the lambs, the smaller percent of lambs raised and the smaller gains produced plainly indicate that the feeding of such a ration is not a good practice so long as alfalfa (or clover) hay may be secured at an at all reasonable price for a part or all of the roughage.

RESULTS FROM FEEDING SIMILAR RATIONS TO DIFFERENT LOTS OF BREEDING EWES

In all feeding experiments there is always a question as to how much of the difference shown by the different lots is due to the rations fed and how much is due to other factors, such as individuality of the animals, location of the pens in which they are fed, etc. While these outside influences cannot be wholly eliminated, they can be materially reduced by rigid selection of the animals used and by making other conditions as nearly uniform as possible. The value of experimental work is determined pretty largely by the success of the investigator in eliminating factors other than those which are being studied.

During three of the winters when the experiments previously reported in this bulletin were in progress the Station had a flock of

about 45 ewes which were being used in a breeding experiment, and for this reason it was desirable to have them all given the same treatment. During each of these three winters these ewes were divided into two lots of 21 to 23 ewes each, and fed alike. The results shown in the following pages are of interest as they give some idea of the accuracy of feeding experiments with breeding ewes when care is taken to eliminate so far as possible all factors other than the ration fed.

The sheep used in these experiments were Merino ewes similar to those used in the other experiments in this bulletin. They were bred to two Merino rams and each lot contained as nearly as possible the same numbers of ewes bred to each ram. In all other respects the two lots were made as nearly alike as was possible. The two lots were fed in pens side by side, as nearly identical as they could be made and were given identical treatment, in other respects. The rations fed consisted of corn, cottonseed meal, corn silage and hay. Clover hay was fed in the first two experiments and alfalfa in the third experiment.

FEED CONSUMED

Table XXVII shows the average daily ration consumed per head for each experiment, the percent of each roughage consumed and the number of pounds of silage fed and consumed for each pound of linseed meal fed. As may be seen from this table there was but a very slight variation in the average daily ration consumed by the two lots in any of the three experiments.

TABLE XXVII.—AVERAGE DAILY FEED CONSUMED PER HEAD AND PER CENT OF ROUGHAGE CONSUMED

	Experiment VIII 124 days 1914-1915		Experiment IX 126 days 1915-1916		Experiment X 126 days 1916-1917	
	Lot 1	Lot 2	Lot 1	Lot 2	Lot 1	Lot 2
Average daily feed consumed:						
Concentrates.... ... . pounds..	.49	.49	.46	.46	.62	.60
Hay*. . . . .pounds.	.71	.71	.74	.74	.68	.67
Silage.. ....pounds .	3.98	3.96	3.82	3.80	4.02	3.94
Hay consumed. . . . . percent	94.11	94.02	96.42	96.43	99.15	99.53
Silage consumed .... percent	99.80	99.02	98.68	98.18	97.71	97.64
Silage fed per pound oilmeal fed .... pounds.	10.	10.	9.99	9.99	18.68	18.57
Silage fed per pound oilmeal consumed pounds	10.	9.9	9.86	9.81	18.25	18.13

*Clover in Experiments VIII and IX; alfalfa in Experiment X.

GAINS AND WOOL PRODUCED BY EWES

The initial and final weights of the ewes, the gain produced and the wool produced are shown in Table XXVIII. The gain produced by the ewes includes the weight of the wool shorn and the weight of the lambs both during the experiment.

Table XXVIII shows that the difference in the average daily gain per head produced by the two lots in Experiments VIII and X was very small, but in Experiment IX this difference was 16.28 percent. Because of the probable inaccuracies in the method of calculating the gain produced by the ewes (see page 132), it is not surprising that there were some rather wide differences.

TABLE XXVIII.—GAINS AND WOOL PRODUCED BY EWES

	Experiment VIII 124 days, 1914-1915		Experiment IX 126 days, 1915-1916		Experiment X 126 days, 1916 1917	
	Lot 1	Lot 2	Lot 1	Lot 2	Lot 1	Lot 2
Initial weight.....pounds..	(23) 2043	(22) 1977	(23) 2168	(23) 2160	(21) 1916.5	(22) 1991.5
Final weight.....pounds..	(22) 2190.5	(22) 2236	(23) 1885	(23) 1868	(20) 1675	20) 1706.5
Ewes died.....number..	(1) 70	.....	.....	.....	(1) 57	(2) 125.5
Weigt of lambs born.pounds.	(21) 186.5	(19) 143.25	(26) 222.75	(25) 210.5	(23) 202	(22) 195.5
Total gain[4].....pounds..	633.25	619.75	145.75	124.25	188.4	195.4
Average daily gain..pounds	.223	.227	.050	.043	.074	.073
Wool produced: Total pounds	229.25	217.5	206.	205.75	170.9	159.4
Average.....pounds .	9.97	9.88	8.96	8.95	8.54	7.59

[4]Includes weight of lambs born and wool produced.

The average weight of fleece was practically the same in Experiments VIII and IX, but in Experiment X there was a difference of 12.5 percent.

WEIGHT AND GAINS BY LAMBS

Table XXIX shows the average weight of the lambs at birth and at ten days of age. In Experiments IX and X this table also shows the average weight of the lambs at the close of the experiment and the average daily gain produced. Experiment VIII closed soon after the ewes had lambed, so the average daily gain is not shown.

Table XXIX shows that in none of the three experiments was there a variation of as much as ten percent between the two lots with respect to the weight of the lambs at birth, at ten days of age and at the close of the experiment and in the average daily gain per head produced by the lambs.

TABLE XXIX.—WEIGHTS AND GAINS PRODUCED BY LAMBS

	Experiment VIII 124 days, 1914-1915		Experiment IX 126 days, 1915-1916		Experiment X 126 days, 1916-1917	
	Lot 1	Lot 2	Lot 1	Lot 2	Lot 1	Lot 2
Average weight at birth: Singles	(18) 9.17	(15) 8.35	(18) 9.28	(21) 8.67	(17) 9.19	(20) 8.97
Twins	*(7) 8.43	(8) 6.94	(10) 6.92	(4) 7.12	(6) 7.62	(2) 8
Average weight at 10 days of age: Singles	(17) 13.79	(14) 13.71	(17) 13.12	(17) 12.76	(16) 12.84	(19) 12.09
Twins	(5) 12.75	(7) 10.07	(9) 9.75	(3) 9.33	(4) 9.37	(1) 11
Average weight at close of experiment: Singles			(17) 19.03	(18) 20.36	(16) 29.59	(18) 28.53
Twins			(7) 13.57	(3) 13.33	(2) 24.25	(1) 26
Average age at close of experiment: Singles			(17) 29.47	(18) 32.67	(16) 63.31	(18) 64.22
Twins			(7) 29.	(3) 16.67	(2) 62	(1) 59
Average daily gain during experiment: Singles			(17) .329	(18) .344	(16) .321	(18) 305
Twins						

*One set of triplets included.

COST OF RATIONS

Table XXX shows the amount of feed fed to each lot, the value of the feed and the average daily cost per head, with feed at the prices shown in the table. This table shows that the greatest variation in the average daily cost of the rations fed was less than two percent.

TABLE XXX.—COST OF RATIONS

Experiment VIII, 1914-1915	Lot 1		Lot 2	
	Pounds	Value	Pounds	Value
Corn at 70 cents per bushel	250.	$ 3.12	249.	$ 3.11
Linseed meal at $36 per ton	1133.5	20.40	1091.5	19.65
Clover at $10 per ton	2130.	10.65	2046.	10.23
Silage at $4 per ton	11334.	22.67	10917.	21.83
Total cost of feed		$56.84		$54.82
"Sheep days" in experiment		2840.		2728.
Average daily cost of feeed per head, cents		2.00		2.01

Experiment IX, 1915-1916	Lot 1		Lot 2	
	Pounds	Value	Pounds	Value
Corn at 70 cents per bushel	220.	$ 2.75	220.	$ 2.75
Linseed meal at $36 per ton	1122.5	20.20	1122.5	20.20
Clover at $10 per ton	2214.	11.07	2214.	11.07
Silage at $4 per ton	11216.	22.43	11216.	22.43
Total cost of feed		$56.45		$56.45
"Sheep days' i n experiment		2898.		2898.
Average daily cost of eed per head, cents		1.95		1.95

Experiment X, 1916-1917	Lot 1		Lot 2	
	Pounds	Value	Pounds	Value
Corn at 70 cents per bushel	1066.2	$12.58	1029.3	$12.87
Cottonseed meal at $30 per ton	560.	8.40	582.7	8.74
Alfalfa at $12 per ton	1759.	10.55	1804.5	10.83
Silage at $4 per ton	10467.	20.93	10820.	21.64
Total cost of feed		$52.46		$54.08
"Sheep days" in experiment		2546.5		2680.
Average daily cost of feed per head, cents		2.06		2.02

In the foregoing tables it was shown that the only important difference between the two lots that exceeded 10 percent was in the average weight of fleece for one year. This would indicate that in feeding experiments with breeding ewes, differences in excess of 10 percent may be credited to differences in the rations, provided care is exercised to have all other conditions as nearly alike as possible.

Because of the larger number of factors involved it seems reasonable to expect wider variations, between lots treated alike, with breeding ewes than with fattening sheep or lambs.

SUMMARY

Silage that is free from mould and relatively low in acidity may be advantageously used in rations for breeding ewes if properly combined with other feeds.

Silage, when properly supplemented with cottonseed or linseed meal, may be substituted for clover or alfalfa to the extent of furnishing at least one-half the dry matter in the roughage, or three pounds of silage to one pound of hay. Such a substitution of silage for clover and alfalfa did not lower the efficiency of the ration, and at usual prices for feeds, effected a material saving.

Silage, even when properly supplemented with a nitrogenous concentrate, does not give satisfactory results with breeding ewes unless it is also supplemented with some form of dry roughage. Silage as the sole roughage makes a cheap ration but the poor results produced do not justify the use of such a ration except under very unusual conditions and prices. Leguminous roughages are the most efficient to feed in connection with silage.

Feeding as small an amount as one-third of a pound of alfalfa to breeding ewes daily per head in addition to all the silage they would consume (about four pounds daily per head), along with corn and cottonseed meal gave excellent results. When two and three times that amount of alfalfa was fed and the amount of silage consumed correspondingly reduced the only noticeable effects which seemed to be consistent were a slight increase in the percent of lambs raised and a material increase in the cost of the ration. The results do not indicate any great advantage from feeding the larger amounts of alfalfa, unless an abundance of alfalfa or a shortage of silage would seem to make it desirable.

The data yielded by these experiments indicate that when only a very limited amount of alfalfa or clover is available for feeding breeding ewes, slightly better results may be secured by feeding a small amount of hay (one-third of a pound per head) along with silage each day throughout the experiment than by feeding a larger amount every other day and feeding silage as the sole roughage on alternate days, or than by feeding silage as the sole roughage during the first half and silage and hay as roughage during the latter half of the experiment.

When alfalfa or clover hay is not available, a fairly satisfactory ration for breeding ewes may be secured by substituting corn stover for hay when fed in connection with silage, provided the silage and stover are supplemented with a protein concentrate.

Corn stover and silage proved much better than silage alone as roughage. However, a ration in which the silage was supplemented with even a small amount of alfalfa (one-third of a pound daily per head) produced more satisfactory results than a ration of silage and corn stover.

The addition of linseed meal to a ration composed of corn, clover and silage caused the ewes to produce a more generous flow of milk and increased the gains produced by the lambs.

Supplementing silage fed in connection with corn and clover hay, with 1 pound of linseed meal to each 10 pounds of silage fed gave more satisfactory results, as measured by the milk flow produced by the ewes and by the vigor of the lambs and the gains made than did the feeding of 1 pound of linseed meal for each 30 pounds of silage.

In some cases at least, there was evidence to indicate that the character of the ration fed had some influence on the birth weight of lambs, but this effect was much less noticeable than on their weight at 10 days of age and at the close of the experiment. This would indicate that while the ration fed at any time during the winter is important, for proper development of the foetus, special attention should be given to the ration fed during the suckling period if strong lambs are to be produced.

These experiments indicate that in the matter of rations the breeding ewe has a wide selective range and that no limited number of feed combinations are absolutely essential or are the most efficient and economical under all circumstances. The feeder should avoid such extremes in rations as, for example, corn and corn stover on one hand and corn and corn silage on the other. Between these extremes the feeds usually produced on corn belt farms—corn, oats, silage, corn stover, oat straw, clover and alfalfa—supplemented with cottonseed or linseed meal, make possible a large number of combinations which will give satisfactory results, thus making the choice of the ration largely dependent on the supply and price of these feeds.

In experiments where similar lots of ewes were fed and treated alike, the difference in results was less than 10 percent, indicating that in such experiments, differences in excess of 10 percent may be attributed to differences in rations.